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# ALASKA

VOLUME XII



HARRIMAN ALASKA EXPEDITION  
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# ALASKA

VOLUME XII

## ENCHYTRÆIDS

BY GUSTAV EISEN

## TUBICOLOUS ANNELIDS

BY KATHARINE J. BUSH



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EDWARD H. HARRIMAN

## PREFACE

THE present volume comprises two papers: The Enchytræidæ of the West Coast of North America, by Dr. Gustav Eisen; and the Tubicolous Annelids of the tribes Sabellides and Serpulides from the Pacific Ocean, by Miss Katharine J. Bush. The manuscript on the Enchytræidæ was placed in my hands about three years ago. Owing to unavoidable delays in the preparation of the volumes which precede it in the series, earlier publication has been impracticable. This is greatly to be regretted, particularly since some of the species then described as new by Dr. Eisen have been since published by others.

The manuscript on the Tubicolous Annelids reached me in January, 1904, when Dr. Eisen's paper was already in page proof, and just in time to be included in the volume.

Both papers represent an enormous amount of patient painstaking original work on little known groups, our knowledge of which is correspondingly advanced. The number of new species and subspecies described is 100, of which 52 are Enchytræids, 48 Tubicolous Annelids. Besides the new species, Miss Bush proposes 15 new genera.

C. HART MERRIAM,  
*Editor.*

WASHINGTON, D. C.  
April 10, 1904.



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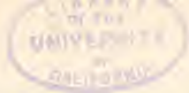
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ENCHYTRÆIDÆ OF THE WEST  
COAST OF NORTH AMERICA







# ENCHYTRÆIDÆ OF THE WEST COAST OF NORTH AMERICA

BY GUSTAV EISEN

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## INTRODUCTION

THE following paper is based principally on the Enchytræidæ collected by the Harriman Expedition to Alaska in 1899. The specimens were placed at my disposal for study by Prof. W. E. Ritter, of the University of California, and by Prof. Trevor Kincaid, of the University of Washington. At the time these specimens were sent me, I was already working up a collection of Enchytræidæ previously obtained in Alaska by Prof. Trevor Kincaid and Prof. W. A. Setchell, the latter principally on the island of Unalaska. Other specimens had been received from Dr. Richard C. McGregor, of San Francisco, and still others had been collected by myself. Another small collection had long been in my possession, having been brought together by Dr. Anton Stuxberg during the Vega Expedition under Baron A. E. Nordenskiöld in 1877. Of the

latter only those species collected in Alaska are described in this paper. With the permission of Mr. E. H. Harriman I have included descriptions of all the above collections in the present paper, which thus becomes much more valuable and exhaustive.

The number of species found within a really limited territory will probably prove a surprise to students of this group of animals; and it must be remembered that none of those who contributed the collections made a specialty of this group. A few specimens were collected here and others there, every collector having some other special branch to look after. Still the result is most gratifying, as the forty six new species increase the total from 128 to 174. While the specimens from Alaska have all been carefully gone over and all the species described, the same cannot be said of other specimens in my collection. Owing to unforeseen circumstances this paper had to be brought to a speedy close and many species had to be left out which undoubtedly would have proved to be new. I have yet in my possession some fifty or more new species collected on the Pacific Coasts by myself, and by Dr. Stuxberg during the Vega Expedition, but time does not allow me to describe them now. My object in mentioning this fact is merely to show the great number of species on the Pacific coast and in the arctic and subarctic zones generally. Nearly every new locality is found to possess new and distinct species, which seem to be much more restricted in their habitat than is the case in Europe. The isolation of species in California is undoubtedly due to the lesser rainfall on this part of the coast, which has prevented the species from rapidly spreading. In the north, along the Alaska coast, *Enchytræidæ* seem to occur in countless numbers, favorable localities being found everywhere. But the further south we go the scarcer become the species and the higher must we go in the mountains in order to find any at all. Compared with the north, *Enchytræidæ* in California are exceedingly scarce, and even during the rainy season we may hunt for several days in apparently favorable localities without finding any. Even in the Sierra Nevada species of this family are comparatively rare. As we go further south, into Mexico,

the species become still more scarce, and those of *Mesenchytræus* seem to disappear altogether.

SAN FRANCISCO,  
March 31, 1900.

NOTE.—This paper was finished and forwarded to the editor a month or so before the publication of the ‘*Oligochæta*’ by Dr. W. Michaelsen. Being unable to use the admirable work of Dr. Michaelsen in the preparation of my paper, I was obliged to postpone until proof-reading some important and necessary changes in the nomenclature of genera, species and organs. These changes I have now made. Thus I have followed Dr. Michaelsen in changing *Pachydrilus* to *Lumbricillus*, and I have also adopted such terms as ‘ampulla,’ ‘peptonephridia’ and others in order to make the terminology more uniform. Since Dr. Michaelsen’s *Oligochæta* was published a few minor publications by other investigators have appeared, containing descriptions of species of Enchytræidæ, especially from the southern part of Europe and the Alps. These species I have as a rule left without consideration, the time being too limited to enable me to make further additions and comparisons.

The types of all or nearly all the species described in this paper have been sectioned up and are now in the form of microscopical slides in the collection of the California Academy of Sciences at San Francisco, Calif. The types of the Vega Expedition will be forwarded to the Royal Academy of Sciences in Stockholm. Cotypes of the species collected by the Hariman Expedition have been deposited with Prof. Trevor Kincaid in the University of Washington, at Seattle, and with Prof. W. E. Ritter in the University of California, at Berkeley.

GUSTAV EISEN.

August 15, 1903.

#### EXPLANATION OF TERMS.

The following terms used in this paper require some explanation in order to be fully understood.

*Accessory glands*.—All glands which open around the base of the sperm-ducts, but which do not originate inside the penial bulb. The accessory glands do not stand in any direct connection with the

sperm-ducts. Typical accessory glands are found in *Mesenchytræus franciscanus*, *M. pedatus*, and *M. solifugus*.

*Ampulla*.—The distal, generally inflated part of the spermatheca. The ampullar part is often furnished with diverticles at its base, these diverticles resembling the ampulla in structure, but differing from the duct of the spermatheca.

*Atrium*.—That enlargement of the sperm-duct situated in the cœlomic cavity immediately adjoining the penial bulb. Sometimes there are two more or less similar enlargements. In such cases the upper enlargement is named atrium, while the lower one, closer to the pore, and which is generally situated inside the penial bulb, is designated 'penial chamber.'

*Atrial glands*.—Glands which are situated free in the cœlomic cavity and which open into the atrium. The ducts of these glands may open between the inner epithelial cells in the atrium, or they may run down in the atrium and open at the base of the sperm-ducts. The atrial glands are also known as prostates.

*Cardiac gland*.—The inner glandular structures in the dorsal vessel (Herzkörper of Michaelsen).

*Chylus cells*.—Large intestinal cells perforated longitudinally by a canal. These cells are found only in a few genera, and generally alternate with common epithelial cells in the intestine. Their form and location are characteristic of the species. Generally located in the vicinity of the clitellar somites.

*Copulatory papillæ*.—The exterior penial papillæ situated close to or surrounding the spermiducal pores. Protuberances serving as exterior copulatory organs.

*Cyanophil lymphocytes*.—Lymphocytes which when double-stained take the blue anilin stains.

*Eosinophil lymphocytes*.—Lymphocytes which when double-stained take the red eosin stain.

*Intra-penial glands*.—Glands which are situated inside the penial part of the sperm-duct. These glands are enclosed by the penial envelope and open at the lower apex of the penis, but always inside, never outside the penis. Typical in *Mesenchytræus harrimani*.

*Penial bulb*.—The bulbous muscular and glandular structure situated at the base of the sperm-duct in *Mesenchytræinæ* and *Lumbricillinæ*. The structure of the bulb is of importance in characterizing the species.

*Penial papillæ*.—Smaller or larger papillæ consisting of unicellular glands situated inside the body in the vicinity of the spermiducal pores. Found only, so far as known, in *Enchytræinæ*. Possibly

also in *Anackætinæ* the cells of the penial papillæ never enter the sperm-ducts.

*Penial chamber*. — The lowest enlargement of the sperm-duct situated below the enlargement designated as atrium. So far as known no glands open into the penial chamber.

*Peptonephridia*. — Glands resembling nephridial structures, opening into the pharynx. The name 'peptonephridia' was first introduced by Benham and later adopted by Michaelsen and others for structures formerly designated as salivary glands. As these structures greatly resemble the nephridial ducts, and differ characteristically from such glandular structures as the segmental and sexual glands, a distinct name for them is appropriate.

*Salivary glands*. — See peptonephridia.

*Sexual papillæ*. — Glandular papillæ projecting exteriorly from the body-wall, in the vicinity of the penial pore. The interior glandular structures are designated 'penial bulb' or 'penial papillæ,' the latter in *Enchytræus*, the former in *Mesenchytræus* and other genera.

*Spermiducal apparatus*. — The sperm-funnels, sperm-duct, penial bulb and accessory, atrial and penial glands.

*Spermatheca*. — Sperm-pockets (Samentaschen). The pore generally in  $\frac{4}{5}$ . The lower narrow part is the duct, the upper thin-walled part is the ampulla, which is often furnished with diverticles at its base.

*Septal glands*. — Unicellular glands, grouped in fascicles, opening in the palate, but often projecting several somites backwards. Septal glands may be both dorsal and ventral.

*Sperm-sacs*. — Sacs covered with integument and attached to the testes. In these sacs the spermatozoa reach their final development. The sperm-sacs are either single, paired, or a separate sperm-sac — testicle-sac — may cap each separate lobe of the plurilobed testes, as in the genus *Lumbricillus*.

*Ventral glands*. — Peculiar cœlomic glands of unknown quality, but probably of sexual nature, found in the vicinity of the ventral ganglion in certain genera. In some instances these glands are intimately connected with the ventral nerve trunk, in other instances they are merely in exterior contact with the ventral nerve trunk. They always penetrate the body-wall and open through it immediately under the ventral nerve trunk. The inner, or distal, ends are free in the cœlomic cavity, or may be united with the ventral nerve trunk. ('Kopulationsdrüsen' of Ude and Michaelsen; 'Copulatory glands' and 'Outgrowths of nerve cords' of Beddard.)

## IMPORTANCE OF THE PENIAL BULB IN CLASSIFICATION.

The present arrangement of the various genera is partly tentative. Until now the structure of the penial bulb has not been critically examined, except in a few species besides those described in this paper, and it is in reality only a supposition that the structure of the penial bulb is uniform in the respective species of a genus. I think, however, this assumption will prove to be correct. The species within each of the genera which have been examined have proved to correspond in all particulars to such an extent that it may be safely assumed that the other species also will agree.

Of the genera of the family, I have not had any opportunity to examine *Bucholzia* and *Achata*. Of *Bucholzia* I have not been able to find any description referring to the structure of the penial bulb, and this genus is simply inserted in the subfamily Lumbricillinae on account of its undoubted relationship to the genus *Henlea*. *Chirodrilus*, which has not been seen by any recent investigator of this family, is appended for convenience sake. Of its interior structure we know nothing.

*Structure of the penial bulb.*—The copulatory cushion or penial bulb is of considerable importance in the classification of Enchytræidæ, and I have as far as it has been possible investigated its structure in all the species described in this paper. In some instances the preservation of the specimens has not been sufficiently perfect to allow a minute microscopical study of these complicated structures, but these instances have been comparatively few, and it seems almost certain that a great uniformity of structure exists in the different species of the same genus, or in the same genera of the various subfamilies. The structure of the penial bulb or corresponding organs can therefore be said to be highly characteristic of both species, genera and subfamilies. As previous investigators have paid little or no attention to the finer structure of these sexual organs I will here refer to them more in detail in order that the following classification may be better comprehended.

In nearly all species of this family there exist one or several peculiar cushions in the vicinity of the spermiducal pore—the pore in which opens the sperm-duct leading from the funnel. This cushion or bulb is either intimately connected with the lower part of sperm-duct in such a way that the lower part of the duct is enclosed by the bulb, the spermiducal pore then being situated nearly in the center of the outer surface of the bulb. Or the pore of the sperm-duct may be sit-



uated entirely exterior to the penial bulb and in no way connected with the many glands which generally are found in the bulb. This latter seems to be characteristic of the subfamily of Enchytræinæ, while the former is the case in the other subfamilies so far as is known.

As regards the structure of the penial bulb there are also some great and very interesting differences. For instance, the bulb may be traversed by numerous trabecula or muscular strands, in two or more directions, longitudinal or fan-shaped, and circular. The former strands run from the body surface to the periphery of the bulb, while the latter form a circular layer in the bulb. These strands separate the glands found in the bulb from each other. In another type of bulb there are no such strands of muscles to be found separating the glands, the latter being closely packed without any intermediary muscles or even connective tissue. The muscular bulb is found in Mesenchytræinæ, while the non-muscular bulb is found in Lumbricillinæ.

In several species the bulb is either insufficiently developed or of a degenerated type, but even in such species there are generally some characteristic features left, enabling us to assign it to its proper type.

In *Lumbricillus* the bulb is surrounded by a thick muscular layer, being a continuation of the body wall. This is also the character of the bulb in *Bryodrilus*, and is probably found in all the other species in the subfamily. In Enchytræinæ the muscles of the bulb are more numerous, forming often a thick padding over the glands of the bulb, and even penetrating between them. But there are no bands of muscles connecting the body wall with the periphery of the bulb as in Mesenchytræinæ. Instead of one single bulb we find in Enchytræinæ a number of smaller and as regards size varying glandular cushions, succeeding one another both in the longitudinal and the transverse diameter of the worm.

If we thus summarize the above facts we find that in this family there exist three distinct kinds of penial bulbs, differing as regards their finer structure.

The Mesenchytræid bulb is a single muscular structure, containing circular muscles as well as fan-shaped muscular bands connecting the body wall with the periphery of the bulb. Between the muscular bands are generally found numerous penial glands which open on the surface of the bulb around the penial pore. The sperm-duct penetrates the bulb, opening on the center of its outer surface.

The Enchytræid bulb is multiple, consisting of several separate cushions grouped around the penial pore. In these cushions we find several sets or fascicles of glands, each fascicle opening by itself on the



surface of the body. There are no muscular bands connecting the base of the cushions with its periphery. The sperm-duct never penetrates the bulbs or cushions but opens close to and independently of them. Exterior to the cushions there are numerous muscles connecting the body wall immediately surrounding the pore with other parts of the same somite.

The Lumbricillid bulb is always single and covered with a strong muscular layer, which however never penetrates down between the cells of the bulb. There are generally two or three distinct sets of glandular cells in the bulb. Some of these open in the lower part of the sperm-duct, or rather in a narrow groove in the elongation of the sperm-duct. Others open on the free surface of the bulb, either irregularly or in narrow circular fields, bunched into fascicles. The sperm-duct penetrates one side of the bulb. In *Bryodrilus* the gland which opens in the extension of the sperm-duct is covered with a thin cushion of muscular strands, forming a bulb within a bulb.

*Structure of the atrium and its glands.*—The structure of the enlargement of the sperm-duct which I have designated as atrium is a complicated one, especially in *Mesenchytraeus*. In the subfamilies of Lumbricillinae and Enchytraeinae the sperm-duct continues to the pore, even through its passage through penial bulb, without any enlargement, and without being joined by any atrial or accessory glands. Any reference to the finer structure of the sperm-duct proper in these two subfamilies is therefore not necessary. But in *Mesenchytraeus* the structure is often so complicated and so varied that it generally furnishes important characteristics of the species. In many species there exists an atrial enlargement just outside of the penial bulb, while many species possess also another enlargement inside the penial bulb, close to the penial pore. For the former I have retained the name 'atrium,' for the latter 'penial chamber.' Both these enlargements may be connected with various kinds of glandular cells. These cells are either single or, more frequently, grouped in fascicles in the same manner as the septal glands. All the various glands in the family resemble one another in that the respective cells open independently of each other through a long and narrow duct. In no instance is there a common lumen for the various cells, though they may be grouped together in fascicles, in which the long and exceedingly narrow ducts run parallel to each other for some considerable distance. This is especially the case with the atrial glands. These glands occur generally in fascicles, which lie free in the coelomic cavity, but send their fine, thread-like ducts into the atrium of the sperm-duct. In many species the ducts of the fasci-

cles are surrounded by circular muscles in the immediate vicinity of the sperm-duct. In other species these circular muscles are wanting. If we follow these fine hair-ducts of the cells we find that some of them after having penetrated the muscular coat of the sperm-duct, enter between the inner epithelial cells of the atrium, and empty their contents into the atrial lumen. Other ducts again do not open into the lumen at once, but run either up or down between the epithelium of the atrium and its muscular layers, and only enter the atrial lumen a considerable distance from the place where they penetrated the atrial covering. In many species the glandular ducts form a thick layer of fine thread-like ducts, which layer is thicker than any of the atrial layers proper. While some of the ducts from the glands enter the atrial lumen without being enlarged or widened out, others first widen out, forming a small pocket in which their granular contents are stored. The number and location of the atrial glandular fascicles vary in different species. In some instances they penetrate the atrium in the same equatorial plane, while in other species they cover the atrium in an irregular manner. In some species these fine ducts of the cells continue downward in the atrium but open only at the penial pore on the surface of the body-wall. In some species the atrial glands are wanting, while in others they seem to be replaced by minute glands situated entirely inside the atrium near the penial pore.

Another set of glands connected with the spermiducal organ consist of accessory glands, which open near the penial pore, but which stand in no connection with either the sperm-duct or the penial bulb. In some species there are many accessory glands arranged in a ring in the cœlomic cavity around the bulb and opening along a circular band around the penial pore. But in other species there may be only two or even one single fascicle of accessory glands opening in a pore by itself, but in the immediate vicinity of the penial pore. In structure these glands resemble the atrial and penial glands (figs. 10, 32). The exterior pore of these accessory glands is often very large, reminding us of the tubercula pubertatis in the higher Oligochaeta.

At the lower end of the sperm-duct we find in many species, both of *Mesenchytræus* and *Lumbricillus*, etc., a set of very small glands which appear to open directly in the sperm-duct. These glands are often enclosed within the muscles of the sperm-duct, and appear as an enlargement of the duct. But it is to be noted that the surface on which these glands open is destitute of any epithelial cells, those of the sperm-duct always ending where the glands commence. I have, therefore, referred to these glands as opening in the prolongation of the

sperm-duct instead of in the duct itself. In the genus *Mesenchytræus* these glands are found only in few species, while in *Lumbricillinae* they are found in all species examined by me.

*The various glands of the spermiducal apparatus.*—In the foregoing as well as in the following paragraphs the various glands of the spermiducal apparatus have often been referred to in their respective places. As their number is considerable and as their structure is somewhat complicated I will here summarize their most important characteristics and endeavor to classify them according to their nature and location. There are at least five different kinds of glands opening into or in the proximity of the sperm-duct.

The first group of glands are those which open in the sperm-duct exterior to the penial bulb. These are the atrial glands which, as we have seen, may directly penetrate between the atrial inner epithelium and open into the atrial chamber and pour their secretions there. Or they may follow between the atrial epithelium and the atrial muscular layers and empty their contents around the penial pore. An illustration of the former is seen in *Mesenchytræus maculatus* (pl. v, fig. 5). The latter is illustrated in *Mesenchytræus grandis* (pl. vii, fig. 2).

Another group of glands in the lowest part of the sperm-duct, or more particularly in the short extension of the sperm-duct, is found in many species of *Lumbricillinae* and in some species of *Mesenchytræus* for which see pl. xi, fig. 4 (*Mesenchytræus asiaticus*), and pl. xv, fig. 7 (*Henlea guatemalæ*). Such glands I have referred to as 'intra-penial glands.'

Another group of glands are designated 'copulatory glands.' These glands are found inside the penial bulb, but do not open into the sperm-duct, but around the spermiducal pore, on the body surface of the penial bulb. Such glands are seen in pl. xi, fig. 4 (*Mesenchytræus asiaticus*), and in pl. xviii, fig. 1 (*Lumbricillus annulatus*).

The copulatory glands may open separately, as in pl. xiv, fig. 1 (*Marionina americana*), or they may open in fascicles in separate pores, as in pl. xv, fig. 6 (*Henlea ehrhorni*). The two kinds of glands may be found in the same penial bulb, and their arrangement and occurrence are probably characteristic of the species.

The fourth class of glands is the accessory glands which open outside of the penial bulb, as illustrated in pl. ix, figs. 5, 6 (*Mesenchytræus pedatus*).

Another set of glands are those found in *Enchytræus*, which open in groups outside of the penial pore (pl. xix, figs. 1 and 6).

# ENCHYTRÆIDÆ OF NORTHWEST COAST OF NORTH AMERICA

## SYNOPSIS OF SUBFAMILIES AND GENERA

### I. Subfamily *MESENCHYTRÆINÆ*.

The penial bulb consists of a muscular cushion containing muscular strands mostly radiating from the base of the bulb, but also running in a peripheral manner. Among these muscular strands are often found numerous glandular cells arranged in sets, which open onto the basal surface of the penial bulb. The sperm-ducts penetrate the bulb but the glands in the bulb do not open into the ducts. Setæ sigmoid in four fascicles on each somite. No dorsal pores.

An atrium and atrial glands generally present. Dorsal vessel rises posterior to clitellum and is furnished with cardiac gland. One pair of sperm-sacs and a single median ovisac. Head-pore generally at the apex of the prostomium. Nephridia pluri-lobed, with wide closely wound canals.....1. *Mesenchytræus* Eisen.

### II. Subfamily *ENCHYTRÆINÆ*.

No large compact penial bulb, only one or more smaller or larger papillæ, consisting of a number of unicellular glands arranged in sets, in which the individual cells radiate in a feathery or fan-shaped manner from a common point on the base of the papillæ. A few muscular strands penetrate between the glandular sets, radiating from the base of the papillæ to the parietes or body-wall situated laterally to the ventral ganglion. Sperm-ducts open independently of the penial papillæ, though in their immediate vicinity. Never any atrium. Setæ always straight when present. Nephridia not pluri-lobed. No intestinal diverticles. Peptonenephridia glands present or absent. No dorsal pores.

Four fascicles of setæ in each somite and more than one seta in each fascicle.....2. *Enchytræus* (Henle).  
No fascicles of setæ. Setæ single or even entirely absent in many somites .....3. *Michaelsena* Ude.

### III. Subfamily *ACHÆTINÆ*.

No setæ, only glandular sacs, projecting from the body-wall into the cœlomic cavity. The penial bulb consists of numerous glandular cells arranged in a fan-shaped manner (the finer details of this structure are not known).

Dorsal vessel rises anterior to clitellum. Unpaired peptonephridia.

Head-pore at the apex of the prostomium. Nephridia with a very large anteseptal, not pluri-lobed. No dorsal pores. Blood colorless. Chylus cells in the intestine.....4. *Achæta* Vejd.

### IV. Subfamily *LUMBRICILLINÆ*.

The single penial bulb contains as a rule no muscular strands, but is covered by a strong investment of muscles, which, however, never penetrate into the bulb. The bulb contains a great number of unicellular glands, which open either on the basal surface of the bulb or into the extension of the duct. The sperm-ducts penetrate the bulb and open in conjunction with the glands. No atrium. No accessory glands. Setæ in fascicles of four. Nephridia not pluri-lobed. Head-pore between prostomium and somite I.

*A.* Setæ always sigmoid and arranged in a fan-shaped manner in the fascicle. Dorsal vessel rises posterior to clitellum. No dorsal pores. No cardiac gland. Blood red. Esophagus gradually merging into the intestine. Sperm-sac caps each testis-lobe. No peptonephridia.

Testes pluri-lobed.....5. *Lumbricillus* Clap.

Testes massive and undivided.....6. *Marionina* Michaelsen.

*B.* Setæ sigmoid or straight. Dorsal vessel rises anterior to clitellum. No dorsal pores. Blood colorless. Intestine with or without pouches.

Dorsal vessel without cardiac gland, rises from an anterior dorsal diverticle of the intestine. Esophagus merges suddenly into the intestine. Rudimentary salivary glands. Setæ sigmoid.

7. *Bucholzia* Michaelsen.

Dorsal vessel rises anterior to clitellum, but not from a dorsal diverticle of the intestine. A cardiac gland. No diverticles of the intestine. Esophagus gradually merging into the intestine. No peptonephridia. Setæ sigmoid.....8. *Stercutus* Michaelsen.

Dorsal vessel rises in the clitellar somites. Intestine with four diverticles in VIII. No sperm-sacs. No dorsal pores. Nephridia

with minute anteseptal. Setæ sigmoid or straight. Rudimentary peptonephridia.....9. *Bryodrilus* Ude. Dorsal vessel rises from a sinus in VIII, formed by the junction of esophagus and intestine, which suddenly merge into each other. Intestine with two to four intestinal pouches or with none. Large peptonephridia. Setæ sigmoid or straight.

10. *Henlea* Michaelsen.

C. Setæ straight, the inner ones always shorter than the outer ones. Dorsal vessel rises posterior to clitellum. Blood colorless. Intestine without pouches. Two kinds of lymphocytes. Dorsal pores in the dorsal median line half way between the septa.

Four fascicles of setæ. Dorsal pores begin with VI or VII. Chylus cells in some somites in the vicinity of clitellum. No cardiac gland. Peptonephridia simple or branched.

11. *Fridericia* Michaelsen.

Only the ventral fascicles of setæ present, anteriorly 4 setæ, posteriorly rarely more than one seta in each fascicle. A cardiac gland. Dorsal vessel post-clitellial. Some of the anterior septa are thickened.....12. *Distichopus* Leidy.

D. Six fan-shaped fascicles of setæ in each somite. Two fascicles are ventral, two lateral and two subdorsal. The setæ in the ventral and lateral fascicles four to nine, simple, acute, curved like an italic *f*; those of the dorsal fascicles stouter and less curved, three to six in each fascicle. Blood colorless.

13. *Chirodrilus* Verrill.

## SYSTEMATIC DISCUSSION OF GENERA AND SPECIES.

### Subfamily *MESENCHYTRÆINÆ*.

This subfamily includes for the present only the single genus, after which the subfamily takes its name. In his arrangement of the family Michaelsen places *Stercutus* close to *Mesenchytraeus* on account of the sigmoid setæ. It seems to me, however, more probable that this genus is more closely related to *Pachydrilinae* on account of the form of its nephridia. The structure of the penial bulb of *Stercutus* is not known to me.

The penial bulb is in some species of *Mesenchytraeus* rather reduced in size as well as variable in structure, but all the species agree in having the lower part of the sperm-duct invested by muscles, which in some instances are of most powerful nature, reminding us of the mus-

cular arrangement of the penial duct in certain species of *Limnodrilus*, where these muscles are spirally twisted around the duct. The ducts enter the penial bulb always from the top, never from the side or from the bottom, as, for instance, in *Fridericia*. Throughout their course in the bulb the ducts are separated by strong muscles from the muscles of the bulb, a character not found in the other subfamilies. The structure of the bulb will be described more in detail under the genus *Mesenchytræus*. For a definition of the family we refer to the synoptic table of the genera.

### Genus *Mesenchytræus* Eisen.

*Definition.*—Setæ sigmoid, generally more numerous in the ventral fascicles. Head-pore generally near the apex of prostomium. No dorsal pores. Dorsal vessel rises posterior to clitellum, with cardiac gland. Blood colorless or red. Brain generally truncate posteriorly, generally broader than long. Nephridia with anteseptal, consisting of the nephrostome, and with a deeply and irregularly pluri-lobed post-septal, in which the ducts are wide and situated close together. No salivary glands. Septal glands present. An atrium generally present. Atrial and accessory penial glands present in many species. A single median ovisac. One pair of sperm-sacs generally of large size. Sperm-duct generally broad and short. Spermatophores present in several species. Penial bulb when present contains muscular strands which radiate from the base towards the periphery of the bulb.

The above definition is slightly modified from the one given by Michaelsen and Beddard. The points in question refer to the color of the blood, to the presence of spermatophores in some species, and to the nature of the penial bulb. An atrium or enlargement of the sperm-duct is found in most species and may be said to be fairly characteristic of the genus; its absence is certainly the exception. In the following we will consider in detail only such characters as are less known.

#### DETAILED DESCRIPTION.

*Brain.*—The form of this organ is less characteristic of the genus than was supposed when the genus was established. The posterior margin, while generally truncate posteriorly, is in many species convex, while in a few it is even concave. But this convexity or concavity is never as large as in the other genera, and coupled with some other characteristics, is frequently a guide to the genus. These supplementary peculiarities of the Mesenchytræid brain are that it is



generally deltoid, tapers posteriorly, and is broader than long. It is also frequently deeply emarginated in front. Whenever we find several of these characteristics together we may be reasonably sure that the species belongs to the genus *Mesenchytræus*.

*Spermathecæ*.—These organs show a great variation in form and in the number of diverticles. The latter offer a most convenient character upon which to base a systematic arrangement of the species. In the following I have adopted the number of diverticles of the spermatheca as a most convenient characteristic for the different groups. There are also points in the structure of the spermatheca which are of great interest. In a large block of species, which also otherwise seem to be related, the terminal ampulla of the spermatheca is greatly enlarged and extends backward through a number of somites. As might be expected, nearly all such spermathecæ are closed and do not connect with the intestine. The exception is found in *M. vegæ* in which the spermatheca is connected with the intestine by a narrow duct, which, however, springs out laterally from the ampulla instead of from its inner apex. There is some little reason to suspect that this enlargement of the spermathecæ in this genus may have been overlooked in some species, and that some spermathecæ which have been described as short and as immediately connecting with the intestine, in reality are greatly prolonged posteriorly. The part adjoining the diverticles is always narrow and closely approaches the intestine. This peculiarity causes it to tear readily and I am satisfied that some such torn spermathecæ have been considered as entire. A similar enlargement of the spermathecæ is not known to exist in any of the other genera of this family.

*Spermiducal apparatus*.—The spermiducal apparatus in *Mesenchytræus* is as a rule most characteristic. This refers especially to the sperm-duct and to the various glands connected with it. In nearly all species of this genus there exists an enlargement of the sperm-duct just before it enters the penial bulb. I have retained for this enlargement the name 'atrium.' In this atrium there open in many species glands, in form, size, and structure resembling the atrial glands of *Limnodrilus*. In some species there are only a few glands, in others there are as many as fifteen or more. The atrial glands consist of fascicles of unicellular glands, each cell opening independently of the adjoining cells. The glands open in various places. As a rule they penetrate the atrial wall in a fascicle surrounded by circular muscles, though these latter may be absent. After having penetrated the atrial wall, the ducts of the glands may open into pockets between the epi-

thelial cells lining the atrium, or the ducts may enter directly between the cells of the atrium. In other species, again, these ducts run all the way down to the pore of the penis and open there between the epithelial cells, or they may continue to the very pore, opening onto the free surface around the pore, still remaining inside the sheath of the sperm-duct. In some instances the ducts of these glands spread out between the epithelium and the muscular layers of the atrium and form a thick layer of irregularly running threads. Some of these narrow ducts run upwards in the atrium, while others run downwards to the pore some little distance before they finally penetrate the epithelium of the atrium in order to empty their contents in the atrial lumen. Through this arrangement nearly the whole anterior surface of the atrial lumen is evenly lubricated by the secretions of the glands and clogging at any given point is most effectually prevented. The individual ducts of the glands are so minute that they may be readily mistaken for fibers. The lumen of the duct is not demonstrable by present microscopical means and the nature of the duct can only be judged by following some of the ducts until they empty their content in the atrial chamber. The great variety of arrangement of these glands is illustrated in the various figures.

*Accessory glands.* — As 'accessory glands' I have referred to glands which open around the penial bulb and which do not enter this bulb. In structure the accessory glands resemble the atrial glands, and like them are composed of fascicles of unicellular glands, the ducts of which never fuse. Accessory glands are comparatively rare. So far they are found in only a few species, such as *M. pedatus*, *M. solifugus*, *M. fontinalis*, and *M. franciscanus*. In the latter species there is only one accessory gland, but this one is of enormous size (pl. iv, fig. 4).

*Penial glands.* — As 'penial glands' I refer to all glands which are confined to the penial bulb. They are of at least three distinct kinds, according as they open into the sperm-duct, into the penis, or simply<sup>e</sup> around the penial pore. The majority of the penial glands open around the pore outside of the sperm-duct. Other smaller glands penetrate the sperm-duct from the exterior, while other glands are entirely confined to the interior of the sperm-duct. Of the latter we have examples in *M. asiaticus*, *M. maculatus*, *M. grandis*, and *M. beringensis*.

Any of the above-mentioned glands may be present or absent. Very few species possess all the various kinds, and in but one species, so far as now known, are they all absent. The presence or absence of

the various kinds of glands constitutes most excellent species characteristics.

*Penial bulb.*—As ‘penial bulb’ I designate the large muscular cushion which in the vast majority of species, surrounds the lower part of the sperm-ducts. This penial bulb differs in structure from the corresponding organ in all the other genera of this family, so far as they are known to me. In *Mesenchytræus* the penial bulb is made up of a large number of muscular strands, both longitudinal and transverse. Between these strands are situated the penial glands. In the penial bulbs of the other genera there exist no such muscular strands, the bulb consisting simply of a large number of unicellular glands situated close together and surrounded by a thin muscular covering, there being no muscles inside the bulb. This structure of the penial bulb is so characteristic that I have added it to the definition of the genus. In no single instance is a penial bulb of the construction so common in *Mesenchytræus* found in any other genus, and similarly in *Mesenchytræus* no bulb of a structure similar to that of *Lumbricillus* and *Fridericia*, etc., has ever been observed.

On the other hand, it is true that in some species of *Mesenchytræus* we meet with a greatly degenerated penial bulb. Thus, for instance, in *M. fontinalis* and in *M. pedatus* the penial bulb is so diminished that it may be said to be virtually absent, its place having been taken by a few penial glands surrounding the pore.

In *M. orca* and *M. kincaidi* the bulbs are small and not furnished with any glands, but their muscular structure is distinct.

*Spermatophores.*—In my original definition of the genus *Mesenchytræus* (Eisen '79) I mentioned the presence of sperm-balls. Since that time no similar structures have been observed in any Enchytræid species until now. As will be described more in detail, spermatophores are actually present in several species and are especially prominent in *M. franciscanus*. The spermatophores are found free in the cœlomic cavity after having been fully developed in the sperm-sacs. In the species described in this paper the spermatophores are never found in the sperm-funnels or in the spermathecæ. This, however, does not exclude the possibility that in other species they may be found to occur in such organs.

## SYNOPSIS OF SPECIES OF MESENCHYTRÆUS.

In order to facilitate the examination of the various species of this genus, I have compiled the following table, based on a reexamination of the old descriptions of such species as were previously known. It need hardly be stated that in none of the older descriptions was the structure of the atrium and its tributary glands referred to in detail. This makes it necessary to base the arrangement of the species on some other characters, as, for instance, on the presence or absence of diverticles of the spermatheca and upon their number. The largest number of species belongs to the group with two diverticles. This group may be further subdivided according to the nature and size of the spermathecae. Other subdivisions are based on the presence or absence of the glands accompanying the sperm-ducts. In the following table I have enumerated several species which are insufficiently described, but which are sufficiently well defined to be identified. This refers to all species which have been described from dissections only, the finer histology not having been studied.

## I. SPERMATHECA WITHOUT DIVERTICLES.

1. Sperm-ducts thick and short. Penial bulb long and tapering. Small penial glands confined to the bulb. No atrial and no accessory glands. Spermatheca twisted at the pore. Brain posteriorly strongly emarginated.
  1. *M. unalaskæ* sp. nov.
2. Sperm-ducts short and narrow. Spermatheca straight and of even thickness. Head-pore between prostomium and somite I. Body transparent. Brain posteriorly slightly convex. Sperm-sac confined to XII.
  2. *M. fenestratus* (Eisen, '79).
3. Sperm-ducts short and narrow. Penial bulb short and ellipsoidal. Spermatheca straight and of even thickness. Brain posteriorly slightly emarginated. Narrow part of sperm-funnel helix-like.
  3. *M. falciformis* Eisen, '79.
4. Sperm-ducts short and broad, three or four times as long as the funnel. Spermatheca with an apical ampulla at the junction with the intestine. Brain slightly emarginated posteriorly.....4. *M. flavidus* Michaelsen, '87.
5. Spermathecal pore not conspicuous. Spermathecae club-shaped. Body dark, pigmented, but not quite black. Brain posteriorly concave. Ice worm from Malaspina Glacier.....5. *M. niveus* Moore, '89.
6. Setae, dorsal: 3 to 5; ventral: 6 to 9. Head-pore at apex. Brain square, posteriorly emarginated. Sperm-funnel about square, small. Sperm-duct short. Spermatheca sac-like, folded, without diverticle; connected with intestine; duct half as long as the ampulla.
  6. *M. montanus* Bretscher, '99.
7. Sperm-duct short and thin. Spermatheca large, sac-like, not connected with intestine. Brain posteriorly deeply emarginated. Setae 3 to 6. Lymphocytes pointed oval, dark with large granules.....7. *M. tigrina* Bretscher.

## II. SPERMATHECA WITH ONE DIVERTICLE.

1. Spermatheca with a pear-shaped diverticle at the center. No enlarged lateral setae. Sperm-sacs confined to XII. Head-pore at the apex of prostomium. Setae: laterals 3, ventrals 5. Funnel short, and sperm-ducts short and hardly convoluted.....8. *M. flavus* Lev., '84.

2. Spermatheca with an olive-shaped diverticle near the intestinal end. Enlarged lateral setæ in V to VII. Head-pore close to anterior margin of prostomium. Brain slightly emarginated posteriorly. Sperm-sac short, confined to XII. Clitellum  $\frac{1}{2}$  XI to  $\frac{1}{2}$  XIV. Glands around the penial bulb.....9. *M. setosus* Michaelsen, '88.
3. Dorsal setæ in IV to VI twice as long as the others (1 or 2 in each somite). Spermatheca?.....10. *M. armatus* Lev, '84.
4. Spermatheca with a small pear-shaped diverticle at the center. No enlarged setæ. Sperm-sacs large, extending back many somites. Head-pore half way between somite I and apex of prostomium. Lateral setæ 2, ventrals mostly 4. Sperm-ducts long. Funnels long.

11. *M. asiaticus* sp. nov.

5. Sperm-ducts short and thick, about five times longer than funnel. Setæ, ventral: 5 to 12, dorsal: 2 to 3, those in V, VI, VII, in dorsal fascicles larger. Spermatheca with one (?) diverticle. Brain posteriorly emarginated.....12. *M. megachætus* Bretscher.

### III. SPERMATHECA WITH TWO DIVERTICLES.

#### A. Spermathecæ unusually enlarged, extending through several somites posterior to V.

1. Spermathecæ not connected with the intestine. Penial glands, about 12 long atrial glands; no accessory glands. Brain square or broader than long.....13. *M. harrimani* sp. nov.
2. Spermathecæ not connected with the intestine. About five atrial glands; penial glands; no accessory glands. Brain rounded.
14. *M. setchelli* sp. nov.
3. Spermathecæ not connected with the intestine. About ten atrial glands; penial glands; one large accessory gland. Brain almost square.
15. *M. franciscanus* sp. nov.
4. Spermathecæ not connected with the intestine. About fourteen atrial glands opening into the atrium in different planes; penial glands; no accessory glands. Brain broader than long, slightly emarginated posteriorly.....16. *M. obscurus* sp. nov.
5. Spermathecæ connected with the intestine. About twelve atrial glands; penial glands; no accessory glands. Brain broader than long, posteriorly emarginated.....17. *M. vegæ* sp. nov.
6. Spermathecæ not connected with the intestine. Several atrial glands; no penial glands and no accessory glands. Brain longer than broad with a slight emargination.....18. *M. orcæ* sp. nov.
7. Spermathecæ not connected with the intestine. At least 12 atrial glands opening in pockets between the epithelial cells; many penial glands; no accessory glands. Brain deltoid, with slight posterior emargination.
19. *M. maculatus* sp. nov.

#### B. Spermathecæ not enlarged and not extending posteriorly beyond somite V. a. No atrial, penial, and accessory glands connected with lower end of sperm-ducts.

Brain posteriorly convex. Diverticles as long as the ampulla of the spermatheca, and much longer than the duct leading to the pore.

20. *M. kincaidi* sp. nov.

#### b. Atrial and penial glands present in connection with the sperm-ducts but no accessory glands at the male-pores.

1. Spermatheca short and thick; diverticles have the form of shallow out-bulgings of the spermathecal wall. Four atrial glands.

21. *M. penicillus* sp. nov.

2. Diverticles longer than the ampulla of spermatheca. Brain posteriorly slightly emarginated. About 8 long atrial glands. Lymphocytes round. Length about 17.9 mm.....22. *M. grandis* sp. nov.

3. Diverticles shorter than the ampulla of spermatheca. Brain broad, posteriorly emarginated. About 6 globular atrial glands. Lymphocytes ellipsoidal, fringed. Length about 15 mm.  
23. *M. fuscus* sp. nov.
  4. Diverticles about equal in length to the stalk as well as to the ampulla of spermatheca. Brain square, truncate posteriorly. Two atrial glands. Lymphocytes ellipsoidal, without fringes.  
24. *M. eastwoodi* sp. nov.
  5. Diverticles simple, slightly shorter than the ampulla of spermatheca. Sperm-duct about equal in length to the funnel. Brain broad, slightly emarginated posteriorly.....25. *M. primævus* Eisen, '79.
  6. Diverticles broader than the ampulla but about as long; shorter than the stalk. Brain posteriorly narrower than anteriorly, slightly emarginated. Head-pore anterior to the center of prostomium. Sperm-duct about 8 times as long as funnel. Lymphocytes ellipsoidal, almost circular. ....26. *M. beumeri* Michaelsen, '86.
  7. Diverticles form merely a central chamber between the duct and the ampulla, in which the paired nature of the diverticles is barely perceptible. No specialized sperm-duct, the narrow part of the funnel serving for duct and opening directly into the pore. Brain posteriorly deeply emarginated.....27. *M. nanus* sp. nov.
  - c. No atrial glands but accessory glands present in connection with lower apex of the penial bulb; penial glands in penial bulb.  
Brain posteriorly slightly emarginated. Two small club-shaped diverticles at the center of the spermatheca.....28. *M. fontinalis* sp. nov.
  - d. No atrial and no penial glands, but many accessory glands at the lower apex of sperm-ducts.  
Brain truncate. Large penial projection of the body-wall.  
29. *M. pedatus* sp. nov.
  - e. No atrial glands. No accessory glands at the male-pore, but many large penial glands inside the bulb.  
Brain slightly rounded, tapering posteriorly. Spermatheca with enlarged pouch opening into the intestine.....30. *M. beringensis* sp. nov.
- IV. SPERMATHECA WITH THREE DIVERTICLES.  
Brain truncate posteriorly. Atrial glands 6 or more. Numerous accessory glands opening exterior to penial bulb. Penial glands in the bulb trefoil-like.....31. *M. solifugus* (Emery, '98).
- V. SPERMATHECA WITH 4 OR 5 GLOBULAR DIVERTICLES AT THE BASE OF THE AMPULLA.  
Spermatheca turret-like. Sperm-ducts very short and broad. Body intensely blackish brown .....32. *M. mirabilis* Eisen, '79.

### MESENCHYTRÆUS UNALASKÆ sp. nov.

Pl. I, fig. 7; and text-fig. 1.

*Definition.* — Length 5 mm., width .4 mm. Somites about 40. Anterior four somites thicker than those following. Somites I to III rugose and warty. Setæ: lateral, 4, 4, 4, 3, 3, 3, 2, 3, 2 (XII), 2, 3, 4, 3, 4, 4, 3, etc., 3, 2; ventral, 7, 7, 7, 7, 7, etc., 0 (XII), 6, 5, 5, 4, 5, 4, etc. Setæ in ventral fascicles diminish in size toward ventral interval; setæ in lateral fascicles of about equal size. Prostomium prominent but not pointed. Clitellum unknown. Sexual papillæ not projecting. Septal glands large, in IV to VI. Brain posteriorly deeply emarginated. Dorsal vessel rises about XVIII. Intestine



posterior to clitellum, with chloragogen glands. Spermathecæ without diverticles, opening into the intestine. Sperm-ducts three or four times as long as the funnels, which are sigmoid. No atrial and no accessory glands. One set of penial glands confined to penial bulb. A pair of long sperm sacs and an ovisac. Nephridia large, plurilobed. Lymphocytes of medium size, eosinophile ellipsoidal. Color of formalin specimen white.

*Locality.*—Unalaska, Aug. 10, 1899. Collected by Prof. W. A. Setchell. Found under moss.

*Characteristics.*—One of the smallest species investigated. Specimens found in August not fully developed, clitellum wanting. No atrial glands could be seen, and no accessory glands. Lymphocytes extremely characteristic, being strongly eosinophilous, with red granules surrounded by a pellucid, uncolored zone. Cells in the tissue too small to allow of a more detailed description.

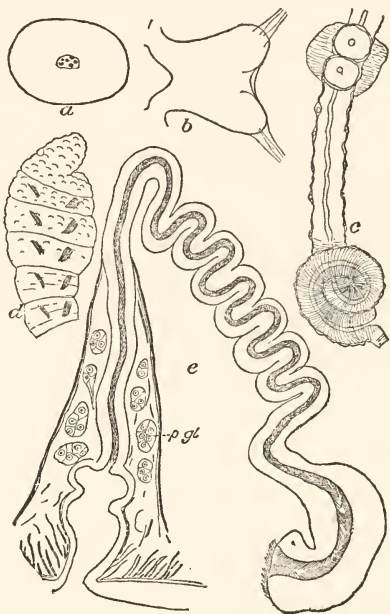


FIG. 1. *Mesenchytræus unalaskæ*.

### MESENCHYTRÆUS ASIATICUS sp. nov.

Pl. XI, fig. 4; and text-figs. 2 and 3.

*Definition.*—Length about 14 mm., width 1 mm. or .9 mm. (contracted specimens). Somites 54. Setæ: laterals, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 2, 3, 3, 2, 2, etc.; ventrals, 4, 4, 4, 4, 4, 5, 4, 6, 5, 5, 0, 4, 4, 4, 3, 3, etc. Prostomium not much pointed, with head-pore half way between apex and somite I. Clitellum prominent, IX to XIII. Sexual papillæ quite prominent. Brain posteriorly more or less deeply emarginated. Dorsal vessel rises behind clitellum. Sper-

mathecæ with long narrow duct and a long narrow ampulla, at the junction of the two a diverticle, variable in size, but always very minute. Sperm-ducts about eight times as long as the cylindrical and slightly curved funnel; atrium with five medium-size atrial glands opening in one plane near the upper end of the atrium. No accessory glands, but

numerous penial glands inside the penial bulb. Two long sperm-sacs extending far backward. One ovisac. Nephridia with unusually large nephrostome. Lymphocytes small, ellipsoidal, pointed. Color pale yellow (alcoholic specimens).

*Distribution.* — Chuckches' Land, to west of Bering Strait, Asia. Collected during the Vega Expedition under Baron A. E. Nordenskiöld, by Dr. Anton Stuxberg, at 'Jinretlen,' June 15, 1879.

*Characteristics.*

—The shape of the

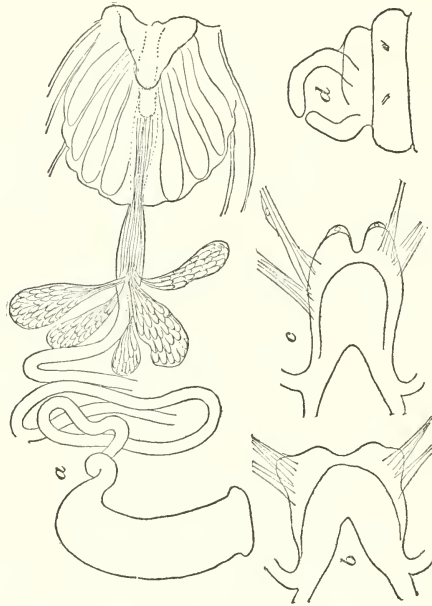


FIG. 2. *Mesenchytrax asiaticus*.

spermathecæ, with their single diverticle and the posterior emargination of the brain, are the leading characteristics of this well-defined species. The large nephrostome distinguishes the species from *M. flavus* Lev, which is said by Michaelsen to possess a small narrow anteseptal. The sperm-duct is much longer than in *M. flavus*.

DETAILED DESCRIPTION.

*Setæ.*—All of equal length; at least no large specialized setæ; average number in ventral fascicles 4.



*Clitellum*.—In fully adult specimens the clitellum is white and stands out prominently. This is also the case with the sexual papillæ, which project about one fourth the diameter of the body.

*Brain* (figs. 2*b* and 2*c*).—This organ varies considerably, but in the majority of specimens dissected the form was about square, more or less deeply emarginated posteriorly and very deeply emarginated

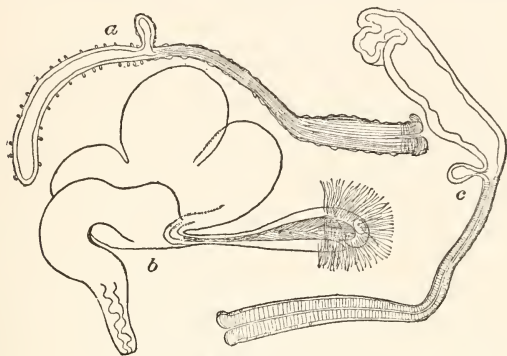


FIG. 3. *Mesenchytræus asiaticus*.

anteriorly. This species is thus one of the very few in this genus possessing a brain posteriorly emarginated. One of the specimens possessed a much more elongated brain than the others, but the emargination was even more deep.

*Spermathecæ* (figs. 3*a* and 3*c*).—These organs do not connect with the intestine. They extend into somite VI and are thus slightly enlarged. Diverticle varies in size. In the majority of specimens the size is as figured, but in one specimen the diverticle constituted a mere warty swelling. The width of the ampulla varies considerably, the two extremes found in the dissected specimens having been figured.

*Spermiducal apparatus* (Pl. XI, fig. 4).—Funnels rather long and slightly curved. Sperm-ducts probably six to seven times (or more) as long as funnels. They are twined and extend back several somites. In this respect they differ from those of *M. flavus*, which species has short sperm-ducts. The number of atrial glands seems to be always five. Penial bulb is broad, and contains a number of penial glands situated close together. At the base of the sperm-ducts and in the ducts are a number of narrow unicellular glands opening inside the sheath.

*Nephridia* (fig. 3, *b*). — A larger and especially a broader nephrostome than any other species examined by me. Nephridia of the somites anterior to clitellum much larger than those in the posterior somites. But the ducts leading to the pores of these anterior nephridia are much shorter than the ducts of the posterior nephridia. In the latter the duct is twice or three times as long as in the anterior ones.

**MESENCHYTRÆUS HARRIMANI** sp. nov.

Pl. I, figs. 1-6; Pl. II, figs. 1-7; and text-figs. 4-6.

*Definition.* — Length 60 mm. or more; width 2.5 mm. or over. Somites about 100, deeply set. The few anterior somites strongly pigmented on dorsal side; the somites following less and less pigmented,

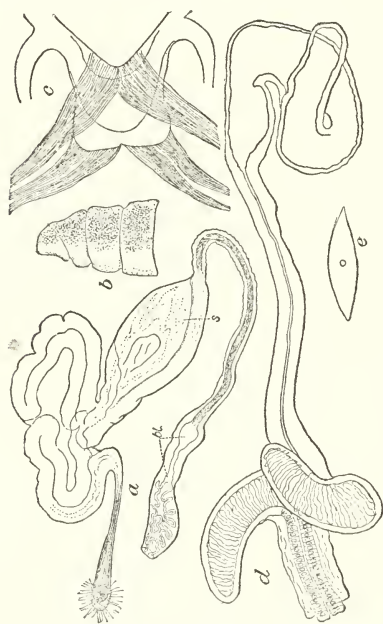


FIG. 4. *Mesenchytræus harrimani*.

the posterior ones not at all. Setæ strongly curved; laterals, 3, 3, 2, 3, 3, 3, 3, 3, 3, 2 (XI), 0 (XII), 3, 4, 3, 3, 4, 3, 3; ventrals, 5, 5, 5, 6, 5, 6, 6, 6, 5 (XI), 0 (XII), 6, 7, 6, 6, 7, 7, 6, etc. Clitellum XI, XII, and  $\frac{1}{2}$  XIII. Sexual papillæ not projecting. Septal glands in IV to VI. Brain square, anteriorly strongly emarginated, posteriorly almost straight and slightly emarginated. Spermathecae unusually elongated, with two strong diverticles near the base; the apical ampulla several times longer than the basal part, extending to somite X or XI. Sperm-duct about three times as long as the atrium and bulb, and about three times as long as the funnel.

Funnel long, narrow, and cylindrical, extending forward through three somites; about six times as wide as the sperm-duct. Bulb large, globular. Atrium

medium size, with about sixteen large gland-fascicles opening at the entrance of the atrium into the bulb. One set of penial glands inside the bulb. Sperm-sacs extending back some thirty somites. Nephridia with two principal lobes and with a small urinary bladder at the pore. From this bladder downward the duct is repeatedly twisted, and at least once branched. Color yellowish, with brownish flush on the dorsal side owing to pigment.

*Locality.*—This, the most gigantic of all the Enchytræids, so far as now known, seems to have an extensive distribution in Alaska, and may possibly reach even as far south as California. Years ago I found a gigantic *Mesenchytræus* at Horse Corral Meadow in the Sierra Nevada of Fresno County, California. The specimen was unfortunately lost before I could describe it, but the similarity to *M. harrimani* is so great that it is not impossible that the two are identical. The elevation of Horse Corral Meadow is maybe about 7,000 feet, so that the altitude would make

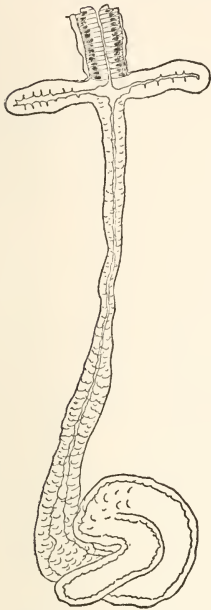


FIG. 5. *Mesenchytræus harrimani*.

up for the latitude. Of course it is impossible to know whether or not the specimen was identical with *M. harrimani*, but the outward appearance, so far as I can remember, certainly was the same. The Alaska specimens were collected by members of the Harriman Expedition, principally as follows: By Prof. W. E. Ritter, Kadiak, Alaska, August, 1899; by Prof. Trevor Kincaid, Orca, Alaska, June, 1899; Metlakatla, June 4; Sitka, June; Lowe Inlet, British Columbia, June; Yakutat, Alaska. I possess also several adult specimens collected by Prof. W. A.

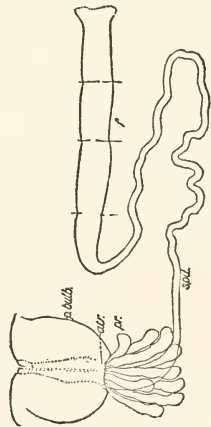


FIG. 6. *Mesenchytræus harrimani*.

Setchell, August 10, 1899, on the island of Unalaska. From notes made by the collectors it appears that the specimens occur both under stones and in sphagnum moss. The specimens from Metlakatla and Lowe Inlet are not quite adult, so there will always remain some slight doubt regarding their identity. Outwardly they resemble the type specimens from the other localities.

*Characteristics.*—With one exception, the largest *Enchytraeus* which has come under my notice resembles in size a veritable *Allolobophora*, but possesses the general color of an Enchytraeid. Form and size of spermathecae and sperm-funnels the most characteristic features.

#### DETAILED DESCRIPTION.

*Brain* (fig. 4c).—Retractor muscles in three pairs; the two posterior ones cover the whole posterior margin of the brain.

*Nephridia* (fig. 4a).—Nephridia large, the ducts are not very distinct in the specimens, probably the effect of the formalin preservative. In the posterior lobe the duct seems to form a wide sinus (fig. 4a, s). At the base of the duct and close to the pore there is a widening of the duct, forming a kind of urinary bladder, from which the duct is branched and repeatedly coiled. No similar structure has come under my observation in any other species. The form of the nephrostome is illustrated by Pl. II, figs. 2 and 3, and requires no further description. The nuclei of the nephridia in all my formalin material are so completely unstainable that they cannot be satisfactorily located.

*Atrium* (Pl. II, fig. 4).—The structure of the atrium offers several points of interest. The cells lining the lower part of the sperm-duct are unusually narrow (Pl. II, figs. 1, 5 and 6). Between them may be seen the very thin ducts of the unicellular atrial glands (Pl. II, fig. 6). These tips penetrate the lumen and hang down into it like cilia. This protrusion of the glandular ducts is more evident on the surface outside of, but close to, the spermiducal pore. Here the epithelial cells are larger and, as they are not ciliated, the protruding ducts are more readily observed. It is probable that a similar arrangement is found in many species with atrial glands, and that only the smallness of the specimens has prevented a correct observation. The tips of the cells are readily mistaken for cilia or loose spermatozoa. In many instances the epithelial cells lie so close together that the tips of the ducts cannot be seen, except with the highest magnifications. In different parts of the lower portion of the sperm-ducts the epithelial cells are of a somewhat different structure. Thus at a point marked 'xx'

the cells are longer and closer together (Pl. II, fig. 1). The unicellular glands open partly inside the atrium, all along the surface marked 'xx' and 'xxx.' Partly also on the free, exterior surface marked 'x' in Pl. II, fig. 5. The cytoplasm of the epithelial cells in question is striated, making it still more difficult to distinguish the free cell-tips, especially in indifferently fixed material.

*Spermathecæ* (figs. 4*d* and 5). — Spermathecæ unusually elongated, extending as far back as somites X or XI. In each somite there is a bulging out of the ampulla, each such sac-like part being separated from the one in the adjoining somite by the constriction caused by the septum. The last two swellings of the ampulla are larger than the others, as wide as the funnels of the sperm-ducts. No connection with the intestine. The spermathecæ resemble greatly those of *M. franciscanus*, except as regards the diverticles, which in *M. harrimani* are heavier and not as long.

### MESENCHYTRÆUS SETCHELLI sp. nov.

Pl. I, fig. 11; Pl. IV, figs. 1-3;  
and text-figs. 7-9.

*Definition.* — Length 12 mm, width .8 mm. Somites, 70. Prostomium pointed. Setæ: laterals, 4, 4, 4, 3, 4, 5, 3, 5, 4, 4, 0 (XII), 2 (XIII), 4, 4, 3, 3, 4, 4, 4, 4, etc., 3, 2, 3, 2; ventrals, 4, 5, 6, 7, 7, 7, 6, 5, 5, 5, 0 (XII), 5 (XIII), 5, 5, 4, 5, 6, 6, 6, 4, 5, 4, 4, 4. Setæ facing the lateral interval smaller; increase gradually in size toward the ventral and dorsal intervals. Clitellum  $\frac{1}{2}$  XI to XIII, with deep inter-segmental grooves. Sexual papillæ small. Septal glands large, in IV to VI. Brain anteriorly deeply concave, posteriorly convex;

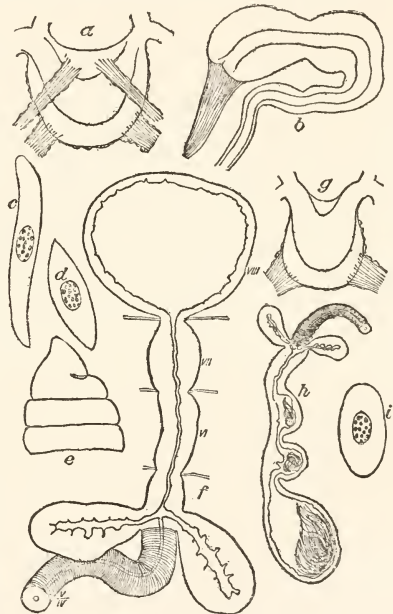
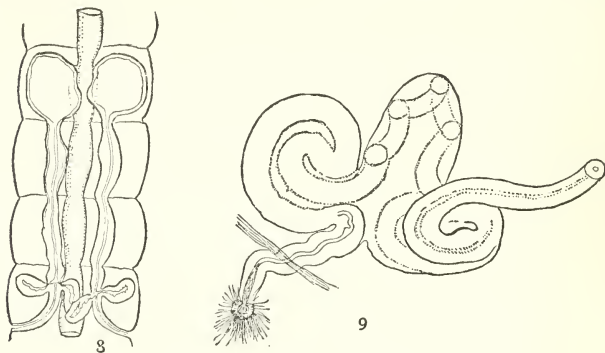


FIG. 7. *Mesenchytræus setchelli*.

IV to VI. Brain anteriorly deeply concave, posteriorly convex;

very thick and swollen. Dorsal vessel rises in XVIII. Intestine very gradually increases in size. Spermathecae strongly bent, at the lower one-fourth furnished with two ovoid diverticles with thick epithelium. The ampulla very long and the apex swollen and



FIGS. 8 AND 9. *Mesenchytraeus setchelli*.

globular; not connected with the intestine. Sperm-ducts about eight times as long as the funnels, which latter are contracted at the middle. Atrium with five atrial glands. Penial bulb with one set of glands, confined to the interior of the bulb. Two long sperm-sacs extending at least as far as XVIII. One ovisac. Nephridia with three large lobes; the anteseptal narrow and tubular. Lymphocytes ellipsoidal and pointed. Color white.

*Locality*.—Unalaska Island, August 10, 1899, Prof. W. A. Setchell. Eight specimens.

*Characteristics*.—The most prominent character is the unusually long spermathecae which extend through several somites, ending in VII or VIII; and which do not connect with the intestine. The ampulla contains numerous spermatozoa and is so large that it fills the whole available space in the somite.

#### DETAILED DESCRIPTION (figs. 7, *h* and 8).

*Spermathecae*.—To the above description of these organs only a few points need be added. The part connecting the diverticles and the ampulla bulges out in places and shows several smaller pouches, in which also balls of spermatozoa were found. The presence of these smaller pouches is however not constant, as they were not found in two of the spermathecae. The wall of the spermatheca is thick in the

lower part, that is, from the ampulla to the pore, but the ampulla itself is very thin-walled. In two specimens the ampullæ rest in VIII, in another specimen they are situated in VII.

*Atrial glands* (pl. iv, fig. 3).—There are five atrial glands opening into the atrium. All possess long ducts, which in some of them run far down into the penial part of the atrium, while others open more directly. There are no circular muscles outside of the main muscular bulb, but inside the bulb such muscles are seen to surround each group of ducts.

*Penial bulb* (pl. iv, fig. 1).—The bulb contains two kinds of glands distinguished by stronger or weaker staining reaction. In the figure the more strongly stained glands are dotted. There are no accessory glands. The inner glands are all narrow, only one or two cells wide.

### MESENCHYTRÆUS FRANCISCANUS sp. nov.

pl. iv, figs. 4, 5*b*, 5*c*, 5*d*, 5*e*, and 5*f*; and text-figs. 10 and 11.

*Definition*.—Length 20 to 30 mm., width 1 mm. or over. Somites about 78. Body strongly tapering toward both ends. Setæ: laterals, 2, 2, 2, 2, 3, 3, 3, 3, 2, 3, 0, 2, 2, 3, 2, 3, 3, 3; ventrals, 5, 5, 5, 5, 4, 5, 6, 6, 5, 5, 0, 5, 5, 6, 5, 4, 5. The most ventral setæ in the ventral fascicles the largest. Clitellum prominent,  $\frac{1}{2}$  XI, XII,  $\frac{1}{2}$  XIII. Sexual papillæ small, a large projectible penis, containing the pore of a single large accessory gland. Septal glands IV to VI. Brain posteriorly straight; posteriorly much narrower than anteriorly. Dorsal vessel rises in XVI. Intestine with chloragogen glands. Spermatophores present in the cœlom. Spermatheca unusually enlarged, extending to X or XII; not connected with the intestine, but terminating in a closed ampulla; the lower part of the spermatheca with two narrow diverticles. Sperm-funnels large; sperm-ducts short, but very narrow; some eight small globular atrial glands opening into the atrium. A single large accessory gland penetrating the penial bulb and opening on a penial projection. Penial bulb contains several small globular glands opening near the pore. Nephridia with two large lobes. Lymphocytes small, pointed, or oval. Color pale lemon yellow. Blood deep orange yellow.

*Locality*.—Under decayed leaves and decaying bark of large lupins, in the wash of the creek entering Laguna Puerca, in San Francisco, California. Adult only in November to January. In February the sexual organs have completely degenerated.



*Characteristics.*—One of the best defined species. Not only is it strongly characterized by its enormous spermathecæ, but also by the large accessory gland-complex opening through the penial bulb onto an external penis, independent of the sperm-ducts. The blood is deep orange. This is also the color of the blood of *M. fontinalis* and *M. grandis*, these three species being the only ones of this genus which I have examined alive.

#### DETAILED DESCRIPTION.

*Spermathecæ* (fig. 11*d*).—The large sac-like part of the ampulla, which extends through many somites, is bent at a right angle against the lower part, which carries the diverticles. For the sake of clear-

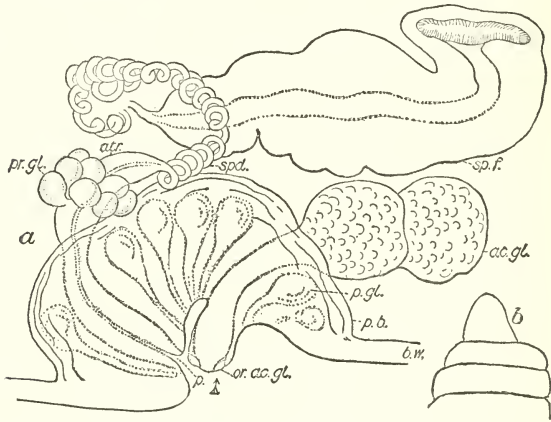


FIG. 10. *Mesenchytræus franciscanus*.

ness this is not shown on the figure. In four specimens sectioned and in two dissected the spermathecæ agreed as regards form. In length they varied, some ending into XI, others in XII.

*Spermiducal apparatus* (Pl. IV, fig. 4, and test-fig. 10 *a*).—Funnel large, extending either backward or forward through two somites, nearly straight, and about 12 times as wide as sperm-duct. Sperm-duct not much more than  $1\frac{1}{2}$  times as long as the funnel; much twisted and difficult to measure. Atrium has the usual form. The part inside the bulb about equal in thickness to the part outside the bulb. In the latter open some eight or more small globular atrial glands. These do not penetrate the penial bulb, but open in a circle all around



the equatorial of the atrium. The most characteristic part of the efferent apparatus is the large accessory gland already described. This gland, which consists as usual of a complex system of unicellular glands, opens by a large and prominent duct into a special penis, which projects far outside the spermiducal pore. In pl. iv, fig. 4, the section of the body passes through the two accessory glands. The atria and spermducts would be cut by sections posterior to this one. The inner lumen of the atrium and the lower part of the sperm-duct or penis proper are lined by large cubical cells, between which the narrow ducts of the atrial glands open. The penial bulb contains a number of the usual glands, separated by muscular fibers and connective tissue. In diameter these glandular masses are about equal to the diameter of the atrium.

*Nephridia*. — These organs are thick and the ducts could not be properly followed. Figure 11*b* represents the average form.

*Spermatophores* (figures in text). — In my earliest paper on Enchytræidæ (Eisen, 13) I gave it as a characteristic of *Mesenchytræus* that the spermatozoa were encysted when they entered

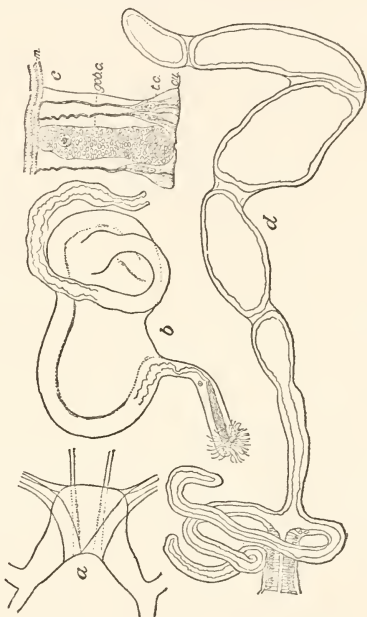


FIG. 11. *Mesenchytræus franciscanus*.

the sperm-funnels. This was found to be the case in all the three species described at that time. In the majority of species of this genus no similar structures have been seen, though Michaelsen has mentioned them (Michaelsen, 4, p. 32) as existing in *M. beumeri*. In some ten or more species of this genus so far investigated by myself, no encysted spermatozoa have been found, but in *M. franciscanus* we find them present in large numbers. As Michaelsen has stated, the testes seem to break up in smaller parts. These smaller parts consist, in *M. fran-*

*ciscanus*, of large nurse-cells, upon which are arranged the minute spermatids in the shape of small globules scattered over the surface. In the earliest stage there is no sign of tails. The nurse-cells (with their charges) to the number of twelve or less are crowded together into a little ball, which is surrounded by a distinct membrane. These cysts or spermatophores begin to develop before they enter the sperm-sacs, but the finishing stages of the spermatozoa are brought about in the sperm-sacs. The cysts are found in the somites anterior to the funnels, but no cysts were found either in the funnels or in the spermathecae. In *M. mirabilis*, as well as in *M. falciformis*, the cysts were found in the funnels. While thus spermatophores are in no wise characteristic of the genus, still they actually occur in several species.

### MESENCHYTRÆUS OBSCURUS sp. nov.

Pl. VI, figs. 1 and 2; and text-figs. 12 and 13.

*Definition*.—Length 22 mm., width 1.75 mm. Somites 78 to 91. Setæ sigmoid: laterals, 5, 4, 3, 3, 3, 4, 3, 3, 4, 3, XII, 3, XIII, 4, 4, 4, 4, 4 (3, 2); ventrals, 10, 10, 10, 10, XIII, 7, 9, 8, 7, 6, 6, 6, 6, (4, 2). Head-pore at apex. Prostomium small, pointed. Clitellum XII and XIII. Copulative papilla small. Septal glands IV to VI. Dorsal vessel rises in XV. Intestine surrounded by chloragogen cells. Spermathecae very large, with two diverticles near the base. The ampulla long and several times folded on itself; walls very thin. Sperm-ducts long, extending backward as far as XVII, about 8 times as long as the funnels. Sperm-funnels slender, with a long recurved rim. Atrial glands from 16 to 20, grafted on the atrium. Large penial glands inside the penial bulb, opening close to the penis. Smaller glandular cells inside the penis. Sperm-sacs large, extend backward beyond IX, X, filling the coelom. Lymphocytes minute, ovoid. Nephridia with three deep lobes. Color dark brown to yellowish brown.

*Locality*.—St. Paul Island, Pribilof group, also Popof Island, Alaska, July, 1899, Prof. Trevor Kincaid.

*Characteristics*.—This species is closely related to the California species *M. fuscus*, but differs in its larger size, in its very dark color due to masses of pigment, and in a larger number of atrial glands opening into the atrium and through its very large but thin spermatheca, which fills the whole available space in the coelom. The number of setæ is greater in *M. obscurus*.

### DETAILED DESCRIPTION.

*Body-wall*.—The layers of the body-wall thick, the general color so dark that no interior organs can be made out except by dissecting.

The color due to thick layers of pigment found principally in the longitudinal muscular layer as well as in the membrane lining the cœlomic cavity. Color varies with the specimens, some a deep chocolate brown, others yellowish or reddish brown. All have a lighter clitellum. (Alcoholic specimens.)

*Brain* (fig. 12*b*). — The brain is anteriorly deeply emarginated; it is broad and short.

*Dorsal vessel*. — Like the intestine, covered by a thick layer of chloragogen glands of a dark brown color.

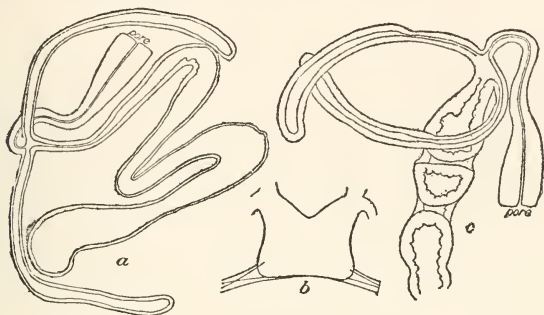


FIG. 12. *Mesenchytræus obscurus*.

*Spermathecae* (figs. 12*a* and 12*c*). — The spermathecae, on account of their great length and twisted nature, were not dissected out entire, and the figures are composed from two or three broken pieces and are accordingly not quite so satisfactory as could be desired. But from a comparison with the sectioned specimen it seems that the form is fairly correct as given. The unusually elongated ampulla extends back to somites IX or X. It is more or less folded, and does not seem to connect with the intestine. The spermathecae are so large that they do not lie abreast, but one is pushed much farther ahead than the other. Thus while one spermatheca had its ampulla strongly folded in somites VI and VII, the other extended to somite X.

*Atrial glands* (fig. 13*c*). — I counted variously 16 to 20 atrial glands. They are grafted on the atrium, surrounding it on all sides, but are more numerous on one side than on the other. They enter the atrium as in *M. fuscus*, but are not surrounded by the circularly twisted muscles found in that species. These atrial glands are free in the cœlom. Enclosed in the penial bulb we find a number of penial

glands similar to those found in *M. fuscus*, but more numerous. The lower part of the penis contains a few long glands enclosed within the penial sheath.

The *sperm-sacs* seem unusually large and extend beyond somite XVIII.

The *lymphocytes* were poorly preserved and their exact shape could not be made out, but they appeared oval and very small.

*Nephridia* (fig. 13a).—More deeply lobed than in any other species, the ducts unusually large, even for a *Mesenchytræus*. The

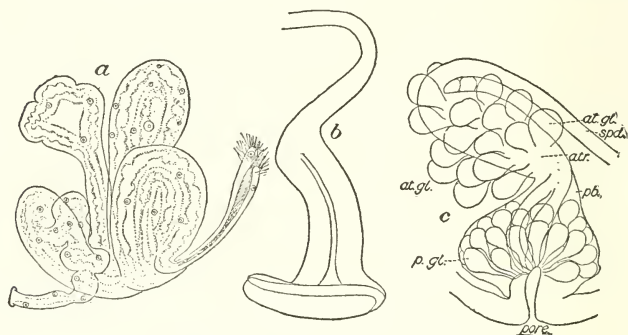


FIG. 13. *Mesenchytræus obscurus*.

nuclei all round. The inner lumen irregular and wide with a large number of wide chambers. The windings shown in the figure are only approximately correct. Not all the nuclei are figured, as many would not stain.

### MESENCHYTRÆUS MACULATUS sp. nov.

Pl. v, figs. 1-5; and text-fig. 14.

*Definition*.—Length 45 to 60 mm., width 1.3 mm. Somites 93. Head-pore far forward. Setæ: laterals, 2, 3, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3; ventrals, 6, 8, 8, 8, 8, 8, 7, 6, 7, 7, 0, 6, 6, 6, 6, 6, etc., diminishing in size towards lateral interval. Clitellum IX, XII and XIII. Sexual papillæ small, white. Brain deltoid, posteriorly slightly emarginated. Dorsal vessel rises posterior to clitellum. Intestine with a thick layer of brown chloragogen cells. Spermathecae unusually enlarged, with two tubular diverticles at the center of the duct; the ampulla at first wide, doubled on itself, then narrower, ex-

tending to VII or VIII; does not connect with the intestine. The spermathecal pore surrounded by a large circular white field, exceedingly prominent. Sperm-ducts narrow. Sperm-funnels of medium size. Atrium with several atrial glands opening into the lumen outside the penial bulb. The penial bulb with many large penial glands (complex) opening around the penial pore; also numerous single glandular cells. A set of smaller glands, confined to the inner and lower part of penis, open in the penial lumen at the pore. Sperm-sacs large, double, extending far back. Spermatophores present in the sperm-sacs, but not in the spermathecæ. One ovisac. Nephridia large, two-lobed, with some inner ciliated ducts. Lymphocytes small, ovoid or ellipsoidal; cyanophil with erythrophil nucleus. Color dying yellow, with the anterior somites deep brown dorsally, due to pigment.

*Locality*.—Popof Island, July 13, 1899, Prof. Trevor Kincaid.

*Characteristics*.—This species resembles greatly *Mesenchytraeus obscurus*, but differs in the following particulars: In *M. maculatus* nearly all the atrial glands open in the same plane, and the terminals of the ducts open in pockets between the epithelial cells. The brain is deltoid. In *M. obscurus* the atrial glands open, each one, almost, in a different plane, and the terminals do not open in pockets. The brain is broader than long. In *M. obscurus* the diverticles of the spermathecæ are much longer in proportion to the balance of the organ than in *M. maculatus*. In *M. obscurus* the large shield around the spermathecal pores is wanting. The two species are undoubtedly distinct, though closely related.

#### DETAILED DESCRIPTION.

*Body* (pl. v, fig. 4; and text-fig. 14 a).—The upper parts of the anterior somites strongly brownish, much more than appears from pl. v, fig. 4, the manner of illustration not permitting of sufficiently heavy shading. The head-pore an oblong, narrow, transverse slit, situated near the apex of the prostomium. The body strongly tapering posteriorly. Besides the general pigmentation of the anterior somites, several parallel brown lines reach from head to tail. Four of these lines run along and surround the fascicles of setæ, the two other lines passing through the spermathecal pores. All through the body there is much pigment deposited in the peritoneum.

*Brain* (fig. 14 c).—Only two posterior retractor muscles, but anteriorly two muscles extend toward the apex of the prostomium.

*Clitellum*.—The clitellar cells small, narrow, and not prominent; extend all around the body. The clitellar cells and the transverse layer of muscles together equal in thickness the longitudinal layer of muscles. All through the body the longitudinal layer is unusually developed. Outside of the clitellum the epithelium and the transverse layer measure one unit each, while the longitudinal layer alone measures thirteen units.

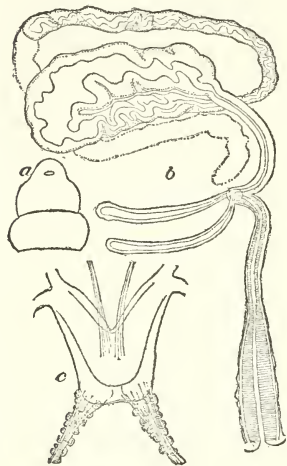


FIG. 14. *Mesenchytræus maculatus*.

*Spermatheca* (fig. 14 *b*).—Only one specimen dissected. Both spermathecae found to be of the same size and form, and there is every reason to believe the form constant, and that the folding of the thick part of the ampulla against the narrow part is characteristic of the species. In one of the spermathecae the apex of the ampulla is narrow and cylindrical, while in the other spermatheca the apex (from the place marked with a +) is thicker and irregular. The folded parts of the spermathecae were alike in both organs. The ampulla extended backward to somite VI. I could not find any connection with the intestine.

The diverticles equal in length the narrowest part of the duct. In one specimen the narrow apical part of the ampulla was much longer than in the other specimens, equalling in length the remainder of the spermatheca. This is indicated by a dotted line in the figure (14 *b*).

*Efferent apparatus*.—As only transverse sectioning was made the relative proportions of the various organs could not be ascertained. Funnels folded on themselves have a flaring lip. Diameter of the sperm-duct equal to one unit, diameter of the atrium equal to three units. Ducts relatively very narrow, confined to the clitellar somites, in which they are considerably coiled.

*Atrial glands* (Pl. v, fig. 5).—At least 12 atrial glands opening into the atrium in the same horizontal plane, immediately outside of the penial bulb; all large, about three times the diameter of the atrium. There may be a few more glands opening into the atrium at a lower plane, immediately below the first one. The individual cells of these

glands are large and contain large eosinophil granules (in the figure black). Their ducts are, as usual, long and narrow. They penetrate the atrial wall, surrounded by circular muscles. After entering, a few of them seem to spread out, but the majority remain bunched together, and enter in this manner between the epithelial cells of the atrial lumen. Here the ducts open their contents of eosinophil granules into pockets of large size. These pockets may readily be mistaken for cells, but favorable cuts show that they are entirely independent of the cells, that they do not contain nuclei, and that they stand in direct connection with the ducts from the glands. Pl. v, fig. 5, which represents a cross-section of the atrium just above the penial bulb, is slightly diagrammatic. There should be a great many more of the large black granules in the chambers, but, in order not to obscure the drawing too much, comparatively few have been shown. The granules are all perfectly globular, but vary somewhat in size, the majority being large. In many places they are seen to be ejected into the atrial lumen.

*Penial chamber* (Pl. v, fig. 2).—Inside the penial bulb the lower part of the sperm-duct is enlarged, forming a penial chamber. This chamber is lined by cubical epithelial cells, between which some ducts from atrial glands seem to open. The lower part of the penial chamber is lined by narrow glandular cells with very fine granulation and with rather large oblong nuclei. The outermost of these cells are different from the rest, having longer and narrower nuclei. They also stain a little deeper.

*Penial glands* (Pl. v, fig. 2).—The glands properly designated penial glands, and confined to the interior of the penial bulb, are of two kinds. The regular penial glands, collected in large bunches, open as usual on the surface surrounding the pore. There are, besides these glands, also a large number of single glandular cells opening into the walls of the penial chamber. They can be clearly seen to penetrate between the muscles of the wall.

*Nephridia* (Pl. v, figs. 1 and 3).—The nephridia are unusually interesting, not so much on account of their form, but because of their similarity to the nephridia of the higher terrestrial Oligochæta. This similarity consists in a network of interlacing ducts, situated immediately below the nephrostome. The network of ducts, considerably finer than figured, soon collects into the outermost canal of the nephridium, the lumen of which duct is quite narrow. Another characteristic of the nephridium is the presence of ciliated ducts. The exact location of these ducts it is not possible to determine at present,



but they are certainly situated in the center of the windings, and do not connect either immediately with the nephrostome, nor with the posterior duct. There are at least 19 nuclei in a nephridium, not counting the row situated transversely in the nephrostome.

### MESENCHYTRÆUS VEGÆ sp. nov.

Pl. III, figs. 1 and 2; text-fig. 15.

*Definition.*—Length 20 mm., width about 1 mm. Somites 85. Prostomium pointed. Setæ sigmoid; ventrals: 7, 8, 8, 8, 8, 9, 7, 7, 7, 8, 7, 0, 6, 6, 6.....5, 5, 4, 4, 3; laterals: 5, 5, 5, 5, 6, 5, 4, 4, 4, 4, 0, 4, 3, 3. Sexual papillæ not prominent. Brain broader than long, anteriorly and posteriorly emarginated. Intestine with chloragogen cells. Spermatheca very large, extending through several somites, connecting with the intestine by a very narrow duct in VII or VIII; two diverticles; the ampulla inflated, sigmoid, tapering to the apex. Sperm-ducts narrow and comparatively long. Atrium and penis, which are wide, connected by a narrow part. About 12 to 14 atrial glands opening in the atrium in the same horizontal plane. Penial bulb with one kind of gland, about four or five in the same plane. No accessory glands. A thin but dense layer of pigment in the peritoneal membrane. No other pigment. Color of the single specimen dark yellow.



FIG. 15. *Mesenchytræus vegæ*.

*Locality.*—Port Clarence, Alaska. Collected by Dr. Anton Stuxberg, July 27, 1878, Vega Expedition. Owing to the fact that the collection contains only a single specimen of this species, the description is necessarily meager. The characteristics, however, are so prominent that the species cannot be confounded with any others so far known.

*Spermathecæ* (Pl. III, fig. 2).—The most characteristic feature concerns the spermathecæ. As the accompanying figure fully illustrates the structure of these organs no further description is necessary. Their structure places this species in the same group as *M. harrimani* and *M. setchelli*, in which species the spermathecæ are unusually large, connecting with the intestine in a somite posterior to V. These species are all characterized by the inflated distal part of the spermathecal ampulla.

*Spermiducal apparatus* (Pl. III, fig. 1).—Penial structure and atrium characterized by the narrow part connecting them; narrow



part about one-half the diameter of the atrium. Atrial glands surrounded by circular muscles at their entrance into the atrium; all in the same, or in almost the same plane, so that a single horizontal section will cut them all at the same relative point. The narrow ducts of the atrial glands do not seem to enter the lumen of the atrium and penis, but continue down to the penial pore. Glands in the penial bulb large, and rarely more than four visible in the same section.

### MESENCHYTRÆUS ORCÆ sp. nov.

Pl. XI, figs. 1 and 2; text-fig. 16.

*Definition.*—Length 6 mm., width .5 mm. Somites 33. Prostomium large, round. Head-pore near apex. Intersegmental grooves deep on ventral side. Clitellum  $\frac{1}{2}$  XI–XIII; clitellar cells unusually large. Body entirely transparent. Setæ: laterals, 4, 4, 4, 3, 4, 4, 4, 4, 4, 3, 3, 3, 3, 4, 4, 3, 4, 4, 3, 3, 3; ventrals, 5, 6, 6, 7, 6, 6, 5, 5, 5, 5, 4, 4, 4, 4, 5, 4, 4, 4, 4, 5, 3, 4, 5, 4. Sexual papillæ small. Septal glands in IV to VI. Brain longer than broad, posteriorly truncate, anteriorly deeply cleft. Dorsal vessel rises in XV. Intestine with a few chloragogen cells. Spermathecae unusually enlarged, consisting of an exceedingly long and slender duct with two minute globular diverticles at the center, and a

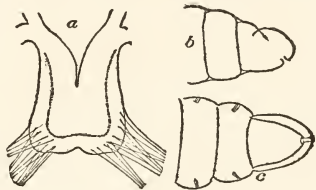


FIG. 16. *Mesenchytræus orcæ*.

long and thick terminal ampulla extending as far back as X; no connection with the intestine. Funnels not above average size. Spermathecae about twice as long as the funnels. Penial bulb narrow, without any penial glands. A set of several large glands pierce the penial bulb and enter the lower part of the sperm-duct just above the pore. No accessory glands. Nephridia with several deep lobes. Lymphocytes disc-like, not large. Color white, no pigment.

*Locality.*—Orca, Alaska, June 25, 1899. Collected by Prof. Trevor Kincaid. Two specimens found under rocks on the seashore, above high tide. Also a few specimens from Yakutat, Alaska.

*Characteristics.*—Not only is the shape of the spermathecae characteristic of the species, but the large atrial glands, which enter the sperm-ducts at the pore inside the penial bulb, distinguish this species from all others in the group with enlarged spermathecae.

## DETAILED DESCRIPTION.

*Body-wall*.—The body-wall thin and entirely transparent, without any pigment in any of the layers. The goblet cells in the clitellum large and square and very prominent, giving the clitellum, when viewed exteriorly, a strongly mottled or marbled appearance.

*Testes*.—Consist of a number of narrow lobes, as in *M. mirabilis*. Sperm-sacs extend as far back as XIV and ovisacs as far as XVII.

*Spermathecæ* (Pl. XI, fig. 1).—Some variation in the size of the various parts. The duct with its small globular diverticles was in one specimen equal in length to the ampulla. In the other specimen the ampulla is much longer and more strongly nipped by the septa. In one specimen the ampullæ extended as far back as VIII, but in the other they reached IX.

*Spermiducal apparatus* (Pl. XI, fig. 2).—The penial bulb hardly encloses any more of the sperm-duct than the pore, at any rate it does not ascend along the duct as in most species. Immediately adjoining the bulb, or in the upper part of the bulb, the atrium is joined by a set of five or more atrial glands. Penial bulb with no glands of any kind; large glands outside of the bulb extend in all directions around the bulb a distance equalling the diameter of the bulb. Atrium itself only a little wider than the sperm-duct. The length of the sperm-duct could not be ascertained, as there was no specimen to dissect, but judging from sections in which it is seen that the ducts do not extend farther back than XIII, it can be concluded that the ducts are not over twice as long as the funnels.

## MESENCHYTRÆUS KINCAIDI sp. nov.

Pl. I, figs. 16 and 17; Pl. VII, fig. 7; text-fig. 17.

*Definition*.—Length 21 mm., width .85 mm. Somites 67. Setæ sigmoid: ventrals, 4, 5, 6, 7, 8, 6, 7, (XIII) 3, 6; laterals, 3, 4, 5, 4, 3, 4 (XII), 13, 4, (2, 2). Prostomium small, somewhat pointed, somite I short. Clitellum XI, XII, XIII, prominent. Copulatory papilla exteriorly not prominent. Septal glands in IV to VI deeply lobed and consisting of several folds. Brain anteriorly very deeply emarginated, posteriorly convex, broader than long. Dorsal vessel rises posterior to somite XV. Intestine covered with a layer of short thin chloragogen cells. Spermathecæ stout, with two diverticles almost as long as the whole spermatheca. Sperm-ducts extend as far back as XVII, thin, but at least seven times as long as the funnels. No atrial glands, no accessory and no penial glands of any kind. The

penial bulb consists exclusively of muscular tissue, and contains no glands. Sperm-funnels are thin and long, and doubled on themselves. Both testes and ovaries are lobed. The testes are connected with each other ventrally. Sperm-sacs are thin, entirely confined to the ventral side of the cœlom. Lymphocytes are small, elongated ovoid, numerous. Nephridia possess one lobe considerably larger than the other. Color gray. Whole body pigmented.

*Locality.* — Ice-House Lake, St. Paul Island, Bering Sea, Alaska. Collected by Prof. Trevor Kincaid, for whom I have the pleasure of naming the species.

*Characteristics.* — The most prominent character of this species is the complete absence of glands connected with the efferent apparatus. Even inside the penial bulb there is nothing but connective tissue and muscular strands surrounding the lower part of the sperm-duct.

#### DETAILED DESCRIPTION.

*Septal glands.* — In transverse sections of the body it is seen that the septal glands are much lobed and consist of two or three folds of unequal sizes. Each lobe is made up of a row of glandular cells along each margin.

*Dorsal vessel.* — So far as I can judge from a series of cross-sections, the dorsal vessel appears to rise in XV. It is thinly covered with very short chloragogen glands. A single row of similar short glands covers also the intestine. The epithelial cells of the intestine of about the same length as the chloragogen cells. A continuous blood-sinus in the intestine, at least in the clitellar somites.

*Spermathecæ* (fig. 17, *a*). — The junction of the spermathecæ and the intestine on the dorsal median line of the intestine. Muscular duct of the spermatheca short. The club-shaped diverticles are of the same length as the ampulla.

*Sperm-ducts* (Pl. VII, fig. 7). — As in many Mesenchytræids, the sperm-ducts extend posteriorly through several somites, in this species as far back as XV. This would make the sperm-ducts about seven times as long as the funnel. They end at the place where the sperm-sacs suddenly widen out. Sperm-duct widens slightly as it enters the penial bulb; no atrium, as in some species, nor can I detect any glands connected with the penial chamber. The *penial bulb* consists of a thickening of the longitudinal muscular layer of the body and contains principally connective tissue interwoven with muscle fibers. When retracted it projects to or slightly beyond the center of the cœlomic cavity.



The *sperm-sacs* are at first very narrow—about as thick as the dorsal vessel. They widen out in XIV, but even posteriorly do not become wider than the intestine, or even as wide, and remain confined to the ventral part of the cœlom. They originate from the tips of the testes.

*Body-wall*.—Integument thick, especially the longitudinal muscular layer. The pigment not continuously distributed, but found in small patches, which latter are evenly distributed throughout the whole length of the body.

*Nephridia* (fig. 17*e*).—Not only is the outside form of the nephridia characterized by a long anterior lobe, but the canals differ also from those of *Mesenchytræids* generally. Instead of being of even

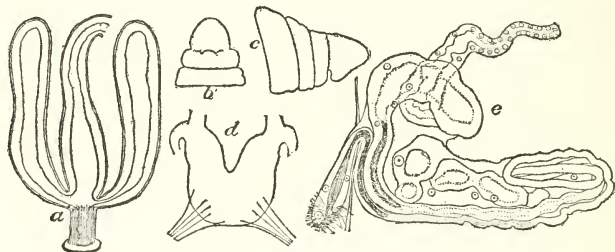


FIG. 17. *Mesenchytræus kincaidi*.

thickness throughout and closely wound, the canals are most irregular, and furnished with a lumen which in places is very wide, and in other places very narrow. In places even the lumen widens out to form regular chambers. There is also a great deal of cellular matrix not belonging to the ducts, and this matrix contains larger and smaller vacuoles which probably stand in connection with the ducts. Near the posterior lobe, where the returning duct connects with the narrow duct leading to the pore, the return duct widens out more than anywhere else and its lumen forms a succession of chambers. These chambers and widenings of the lumen are not exactly similar in the various nephridia, but are subject to such variations that no two nephridia are entirely alike.

#### MESENCHYTRÆUS PENICILLUS sp. nov.

pl. ix, figs. 1 and 2; text-figs. 18 and 19.

*Definition*.—Length 15 mm., width 1 mm. Somites 85. Prostomium small and pointed. Setæ: laterals, 4, 5, 6, 5, 4, 6, (XII)

3, (XIII) 5, 6, 5, 4, 5, 5, 6, 6, (5, 4, 3, 3, 2, 2); ventrals, 6, 7, 7, 7, 7, 7, 0, (XIII) 4, 7, 6, 5, 4, 5, 6, 5, 4, 3, 2. Head-pore far forward. Clitellum XII–XIII. Copulative papilla insignificant. Septal glands in IV to VI. Brain broader than long, posteriorly truncate. Spermatheca short and broad, lopsided, with two short diverticles at the center. Sperm-ducts short, as long as the funnels. Funnels long and narrow. Penial atrium long and rather narrow. Three or four long atrial glands enter this atrium outside of the penial bulb. Some five or six penial glands inside of the bulb opening near the penial orifice. Ovaries and testes in XII and XI. Two large and very long sperm-sacs connecting with the funnels extend backward some fifteen or more somites. Nephridia rounded, with shallow lobes. Nuclei slightly oval. Lymphocytes unknown. Color of alcoholic specimens pale yellowish.

*Locality*.—Port Clarence, Alaska. A single specimen, collected by Prof. Trevor Kincaid, August, 1897.

*Characteristics*.—This species is readily distinguished by the short spermathecæ, which are peculiarly lopsided, one diverticle being thicker than the other. The short sperm-ducts are also characteristic. Owing to want of specimens the detailed description given below is naturally meager. Part of the single specimen was dissected, part sectioned transversely. As will be seen, the species belongs to the group of Mesenchytræids with atrial glands. These glands are larger than in *M. fuscus*. They are also less numerous than in that species, its nearest relative.

#### DETAILED DESCRIPTION.

*Spermathecæ* (fig. 18, *a* and *b*).—Both spermathecæ showed a peculiar lopsidedness.

*Sperm-ducts* (pl. ix, fig. 2).—These are less than one-eighth as long as the funnel. The penial bulb extends nearly to the end of the atrial enlargement in the dissected specimen. In the sectioned half it appears to extend to the middle of the atrium.

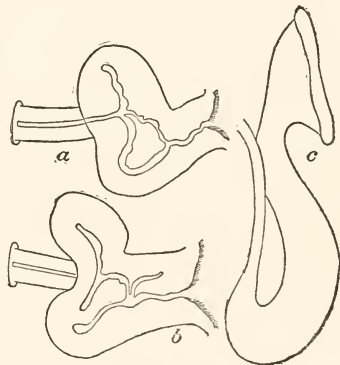


FIG. 18. *Mesenchytræus penicillus*.

The atrial glands push through the bulb, but their larger part lies free in the coelom. There are five or six penial glands inside the bulb,

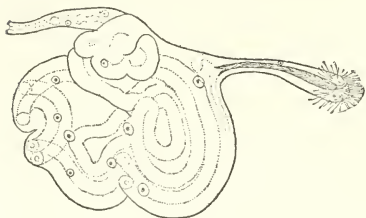


FIG. 19. *Mesenchytræus penicillus*.

opening around the penial pore. The funnels are (in the single specimen) engaged in the sperm-sacs. They are turned backward and lie in somites XII and XIII, instead of in IX, as is usually the case. The atrial glands seem to open mainly on the concave side of the atrium. Pl. IX, figs. 1 and

2, are somewhat diagrammatic, but represent correctly, in a general way, the spermiducal apparatus.

*Nephridia* (fig. 19).—The outlines are rounded and the lobes quite shallow. The nuclei are nearly round and of different sizes. The *lymphocytes* are not known.

### MESENCHYTRÆUS GRANDIS sp. nov.

Pl. I, figs. 8–10; Pl. VII, figs. 1–6; text-fig. 20.

*Definition*.—Length 170 mm., width behind clitellum 1.75 mm., clitellum 2.25 mm. Body strongly tapering, especially toward the tail. Somites 105. Setæ: ventrals, 3, 4, 5, 6, 5, 6, 6, 5, 5, 0, XIII, 1, 5, 6, 6, 5, 5; laterals, 2, 3, 4, 4, 3, 4, 3, 4, 3, 0, XIII, 1, 4, 4, 4, 5, 4, 5. Clitellum very prominent. Prostomium rounded, with a large head-pore far forward. Sexual papillæ distinct, but not large; ovipores prominent. Septal glands in IV to VI. Brain posteriorly slightly emarginated, a little longer than broad. Spermatheca thick, with two long club-shaped diverticles, as long as the duct, ampullar part short. Intestine and dorsal vessel covered with short but dense chloragogen cells. The dorsal vessel rises posterior to XX. Spermiducts about three times as long as the funnels, which latter are unusually long, extending through some six somites backward. The lower part of the sperm-duct with a long and narrow atrium and a large penial bulb. In the atrium open some seven or eight long glands. Some twenty or more penial glands open around the base in the penial bulb. Ovaries and testes absent in the single specimen. Ovisac begins in XVII. Nephridia thick; broad anteseptal; postseptal with three folds; posterior duct thin, nuclei very small, ovoid. Lympho-

cytes of medium size, globular, with some six or more large and densely staining granules. Color pale citron yellow.

*Locality.*—In plants brought from Alaska (probably Sitka or Juneau). Presented by Mr. Alexander Craw. A single specimen which was carefully narcotized and fixed in sublimate.

*Note.*—The specimen having been received late in the year (Sept., 1897), the testes and ovaries had degenerated, as careful search failed to reveal any trace of them whatever. The sperm-sacs, on the contrary, are in a fully developed stage, and full of spermatozoa. The spermathecæ and the sperm-ducts are also in a highly developed condition, and show no sign of degeneration.

*Characteristics.*—Characterized by its spermathecæ, the diverticles of which are as long or longer than the duct, while the ampullar part is short. The sperm-ducts widen out to an atrium, the glands of which are comparatively long. The long ducts of the glandular cells are carried far down the sperm-ducts, opening into the duct all along its course down to the very pore. This species resembles greatly *M. harrimani*, and may be said to be *M. harrimani* with short spermathecal ampulla.

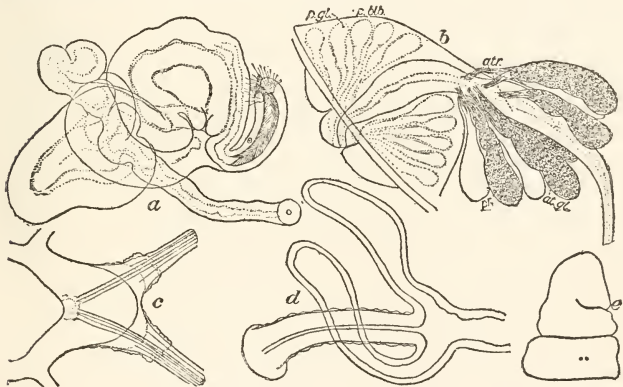


FIG. 20. *Mesenchytræus grandis*.

#### DETAILED DESCRIPTION.

*Brain* (fig. 20, c).—The posterior margin of the brain is so indistinct that it is impossible to say whether it is strongly concave or only slightly so. I have therefore dotted the line indicating the margin. This indistinctness is not due to any tearing in dissecting, but from the



fact that the brain-cells are carried out on the powerful retractor muscles connecting the brain with the body-wall.

*Spermatheca* are strong and rather contracted. They are of large size, even for a worm of the unusual size of our present species.

*Sperm-ducts*.—The funnels long and thin, and in the specimen turned backward. The ducts extend backward some six or seven somites, but on account of the length of the funnels are not over three times as long as the former. The most interesting part of the organ is, of course, the atrial part with its glands. There is a long and narrow atrium outside the bulb and a wider penial chamber within. The openings of the atrial glands are close to the penial bulb and close to each other. As has already been stated, the ducts of the individual cells, after entering the atrium, penetrate its inner layer all along down to the penial pore. The shape of the glands is also somewhat characteristic, being long and even and much less pear-shaped than those of the other species which have so far come under my observation.

*Sperm-sacs*.—The two usual sperm-sacs are present. They begin as far forward as somite VII, where they appear to spring from the septum VI/VII. They gradually increase in size posteriorly, except in the somites of the clitellum, where they are thin, even and tubular. The walls of the sperm-sacs are thick, a cross-section resembling a cross-section of a spermatheca.

*Lymphocytes* (pl. VII, figs. 3-6).—There are in reality two kinds of lymphocytes, one with cyanophil and one with eosinophil granulation. The cells may also be void of any granules, in which case one kind cannot be distinguished from the other. The cells are globular, rounded and mulberry-shaped, as regards outline. The cytoplasm is coarsely reticulate, the nucleus small. In cells with cyanophil granules, the latter are of even size and uniform shape, rather squarish and with blunt ends. There are from six to ten or more of these granules in each cell. The granules are quite separate one from the other. In the other kind of cell the granules are of all sizes, some very minute, others several times larger than the cyanophil granules. Of these eosinophil granules there are many more in each cell, sometimes as many as twenty or thirty. They are frequently thrown out in the coelom, and are here found in all sizes, entirely free from the lymphocytes themselves. The eosinophils are by far the smallest of these two kinds of lymphocytes; the difference in size is however not great. As will be seen, even the lymphocytes resemble those of *M. harrimani* to such an extent that a close relationship exists between the two species.



For want of specimens of *M. grandis* this relationship cannot now be cleared up. It may be possible that *M. grandis* is identical with *M. harrimani*, the spermathecae having become accidentally reduced.

### MESENCHYTRÆUS FUSCUS sp. nov.

Pl. VIII, figs. 3-5; text-figs. 21-23.

**Definition.**—Length 15 mm., width 1 mm. Somites 58. Setæ sigmoid: laterals, 3, 3, 3, 3, 4; postclitellars 3, 3, 4, 4, 4; ventrals, 6, 6, 7, 7, 7, 6; postclitellars, 6, 6, 6, 5 (5, 3, 2). Head-pore large, near the apex. Clitellum, dorsally XI–XIII, ventrally  $\frac{1}{2}$  XI–XIII. Copulatory papilla of medium size. Intestine in II and III much narrower than in the following somites. Septal glands in somites III–VI. Brain posteriorly truncate, anteriorly deeply incised. Dorsal vessel rises in somite XX

and at once is very thick. Spermatheca with two sausage-shaped diverticles nearer the pore than the intestine. The diverticles are about one-third as long as the whole spermatheca. Sperm-ducts about twelve times as long as the funnel, extending back some nine so-

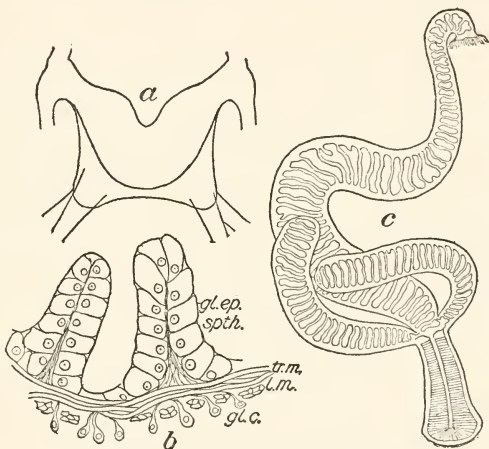


FIG. 21. *Mesenchytræus fuscus*.

mites, or to XXI. Funnels very large, helix-shaped. An atrial chamber into which open independently of each other six to eight glands. Penial glands opening at the base of the sperm-ducts. Sperm-sacs very large, one pair extending as far back as somite XXVII or further. One ovisac. Nephridia with two almost circular lobes. Lymphocytes few, flat and circular.

**Locality.**—In moss in Pit River (below the falls), California. Also from several other localities in northern California. Collected by Dr. Richard C. McGregor.

*Characteristics.*—Externally this species is readily recognized by the tawny color of its anterior somites, especially their dorsal part, which color is caused by scattered granules of pigment. Internally the

species is characterized by its six to eight comparatively large atrial glands, which open directly into the atrium (fig. 22, *a*).

#### DETAILED DESCRIPTION.

*Pigment.*—The granules of pigment are found in both the epithelial cells and in the circular muscular layer, but they are especially numerous in the outer part of the

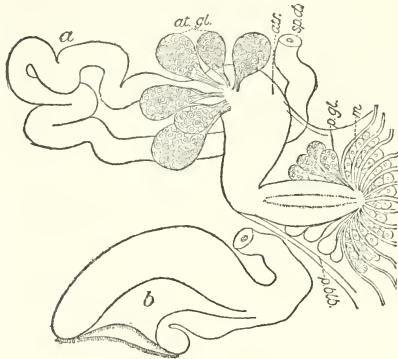


FIG. 22. *Mesenchytræus fuscus*.

epithelial cells of the body-wall. Posterior to clitellum they are absent.

*Head-pore* is situated about half way between the apex and somite I.

*Copulatory organ.*—As in many species of *Mesenchytræus*, the part of the sperm-duct nearest the male pore possesses two chambers joining each other, the outer one being more properly a penis, while the inner one is of a more glandular nature (fig. 22, *a*). In this inner chamber and on the side nearest the intestine open the prostates. In the specimens dissected and sectioned there are some six to eight bunches of these atrial glands, each opening independently in the atrium. The distal end of each glandular fascicle is globular or pear-shaped, while the tubular end duct is narrow. This duct is composed of a mass of tubes, which jointly penetrate the atrium, forming a thick layer of tubes between the muscular and the glandular layers of the atrium (pl. viii, fig. 5). The ducts of each fascicle surrounded by spirally wound muscles, which seem to be mere outcroppings of the outer muscular layer of the atrium. None of these glands open at the base of the penis. The penial bulb consists of muscular strands arranged



FIG. 23. *Mesenchytræus fuscus*.

as the spokes in a wheel, and between the strands are a number of small unicellular glands opening near the pore. Besides these very small glands, there are also a dozen or more larger glands which rise high above the muscular strands (pl. VIII, fig. 5), and which seem to open near to the apex of the penis. There are thus three sets of glands opening in connection with the sperm-ducts: atrial glands and two kinds of penial glands, the smaller of which do not rise above the muscular strand mentioned above. The funnels are thick and helix-like (fig. 22, *b*), and taper very gradually into the sperm-ducts. The sperm-sacs are long and thick, extending from the ventral to the dorsal side of the cœlom.

*Nephridia* (fig. 23) are round with two principal folds with rounded outlines. The duct leading to the pore is thick and helix-like.

*Lymphocytes* few in number, of disc-like form, and quite small.

*Intestine*.—The intestine, both posterior and anterior to clitellum, is covered with a thick coating of brown chloragogen cells.

### MESENCHYTRÆUS FUSCUS INERMIS var. nov.

Pl. I, fig. 18; text-fig. 24.

*Definition*.—Length about 20 mm., width about 1 mm. Somites 75. Setæ sigmoid: laterals; 3, 4, 3, 0, 5, 6, 5, 6, 6, 7, 6, 5 (4, 3, 2); ventrals; 4, 5, 6, 5, 0, 6, 6, 4, 6, 7, 6, 5 (5, 4). Head-pore halfway between apex and the first groove. Clitellum ventrally and dorsally  $\frac{1}{2}$  XI–XIII. Sexual papillæ not large. Septal glands in IV to VI. Brain as in the species, but less emarginated anteriorly. Dorsal vessel rises in somite XXI. Intestine narrower in II and III. Spermatheca with two diverticles near the base, each being two-elevenths as long as the whole spermatheca. Sperm-ducts about twelve times as long as the length of the funnel. Funnel more slender than in the species. An atrium present, in which open four to six glands near its junction with the penis. Penial glands open near the penis. Sperm-sacs very large, extending as far back as XXII. Egg-sac extends at least to XXVIII. Testes and ovaries normal. Nephridia less round than in the species. Lymphocytes small and ovoid.

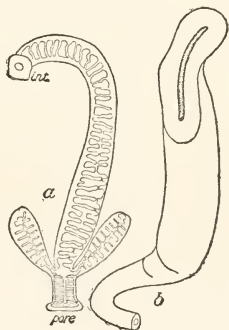


FIG. 24. *Mesenchytræus fuscus* var. *inermis*.

*Locality*.—West Fork of Feather River and Goose Lake, northern Modoc County, northern California, Dr. R. C. McGregor. Several specimens.

*Characteristics*.—This variety differs from the species in the shape of the spermatheca, and in the absence of pigment granules in the body-wall. There is also a difference in the form of the sperm-funnel and in the shape of the prostates, as will be shown below.

#### DETAILED DESCRIPTION.

I will only dwell upon points in which the variety differs from the species.

*Body-wall*.—There are no pigment granules in any of the somites. The specimens are white, those of the species being anteriorly strongly tawny.

*Spermatheca*.—The diverticles of the spermatheca (fig. 24, *a*) are much smaller than in the species, as a comparison of the figures will show. In the species the diverticles are about one-third as long as the whole spermatheca, while in the variety they are two-elevenths as long.

*Spermiducal apparatus*.—The atrial glands enter the atrium nearer the penial chamber than in the species. There is also a difference in the form of the glands, which in the variety are more oblong. In the species they are more rounded.

### MESENCHYTRÆUS EASTWOODI sp. nov.

Pl. I, fig. 12; Pl. VI, fig. 3; text-fig. 25.

*Definition*.—Length 6 to 8 mm., width .6 mm. Somites 65. Setæ: ventrals, 6, 6, 6, 5, 6, 6, 5, 5, 6, 5, 6 (XII), 4 (XIII), 4, 4; laterals, 2, 2, 3, 3, 3, 3, 3, 3, 2, 2 (XII), 2 (XIII), 2, 2, 3, 3, 3, 2. The most lateral setæ in the ventral fascicles and the most ventral in the lateral fascicles are smaller. Head-pore on the upper side of prostomium, which is short, blunt, and rounded. Brain anteriorly deeply emarginated, posteriorly straight; longer than wide. Dorsal vessel rises posterior to XV. Intestine with small flat chloragogen cells. Spermathecae with a pair of cylindrical diverticles at the center, each diverticle being a little shorter than half the spermatheca. Sperm-ducts about eight times as long as the funnels. Funnels small, almost globular, with twisted basal part. A comparatively narrow atrium exterior to the penial bulb. Two long and irregular atrial glands open in the atrium. Six or eight penial glands inside the bulb open at the penial apex. Two pairs of sperm-sacs well developed. Lymphocytes oval, with pointed ends, about one-fifth as long as the narrow diameter of the brain.

*Locality*.—Hoods Peak, Sonoma Co., California, April, 1893, in soil near a creek. Collected by Miss Alice Eastwood. Of some twenty specimens only a few are adult.

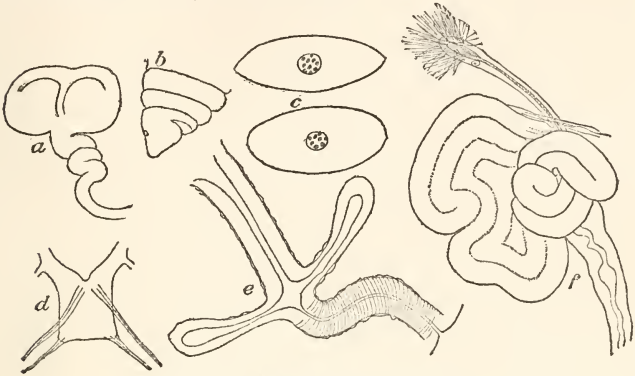


FIG. 25. *Mesenchytræus eastwoodi*.

In size this species resembles *M. fontinalis*. From this species *M. eastwoodi* is well distinguished by its atrial glands, its small lymphocytes, and the arrangement of its setæ, which gradually diminish in size toward the lateral interval.

#### MESENCHYTRÆUS NANUS sp. nov.

Text-fig. 26.

*Definition*.—Length 8 mm., width .6 mm. Somites 56, well defined. Setæ: laterals, uniformly 2, 2, etc., 1; ventrals, 3, 4, 4, 5, 5, 5, 5, 4, 4, 4, 0, 2, 3, 2, etc. Head-pore near apex. Sexual papillæ distinct. Septal glands IV to VII. Brain almost square, posteriorly deeply emarginated. Dorsal vessel rises in XVI. Intestine covered with thick chloragogen cells. Spermathecæ large, confined to one somite, with a large central chamber representing two primitive, opposite, diverticles; apex of spermathecal ampulla appears to be connected with the intestine by a pore. No sperm-ducts; the sperm-funnels (fig. 26, *d*) club-shaped, open directly in the penial pore without any intermediary ducts. There is no penial bulb, and no glands of any kind in connection with the efferent apparatus. Testes and ovaries normal. A single ovisac and two sperm-sacs extending backward through several somites. Nephridia with very long duct and many-lobed central part. Lymphocytes small, ovoid, not fringed.

*Locality*.—Popof Island, Alaska, Prof. Trevor Kincaid.

*Characteristics*.—Only a few specimens were collected, and of these only one was partially adult. The specimen sectioned did not possess any part of the efferent apparatus and no spermathecae. The adult specimen was dissected. The form of the spermathecae and the

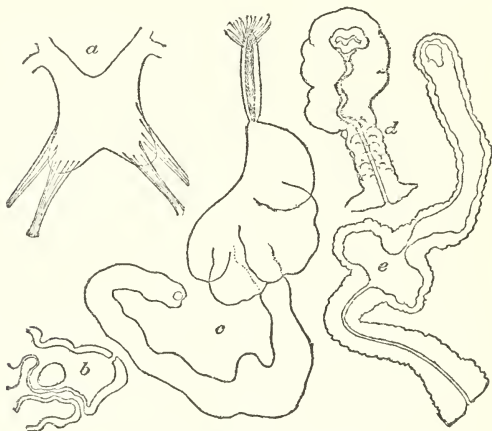


FIG. 26. *Mesenchytræus nanus*.

sperm-funnels opening into the pores without ducts, are so very characteristic that the species cannot very well be confounded with any other species known. The nearest related species is *M. primævus* Eisen, which however possesses a slightly different spermatheca, the difference being in the diverticles and in the length of the organ. The duct leading to the pore in the nephridium is much longer in *M. nanus* than in *M. primævus*.

### MESENCHYTRÆUS FONTINALIS sp. nov.

Pl. I, fig. 15; Pl. XI, fig. 3; text-fig. 27.

*Definition*.—Length 8 mm., width .75 mm. Somites 60. Setæ sigmoid; laterals anterior to clitellum 3, posterior to clitellum 4, 5, 6; ventrals anterior to clitellum 6, posterior to clitellum 7, 6. Head-pore large, situated a little posterior to the apex. Clitellum dorsally  $\frac{3}{4}$  XI–XIII, ventrally  $\frac{1}{2}$  XI–XIII. Sexual papillæ not prominent. Brain posteriorly truncate or very slightly concave. Septal glands large

in IV to VI. Spermatheca cylindrical, with two opposite diverticles on the quarter nearest the intestine. Sperm-ducts about ten times as long as the funnel, furnished with a bottle-shaped enlargement near the pore. No atrial glands. The funnel is very large, three- or four-lobed. Dorsal vessel rises in somite XIX. Sperm-sacs in XII to XVI. Ovisac extends to XVIII. Nephridia with three principal lobes, the general shape deltoid. Lymphocytes very large, oval. Blood orange red.

*Locality*.—Pine Ridge above the toll-house road near the lumber mills, Sierra Nevada, Fresno County, California. Found among decaying leaves and in the mud in the running water of a small tributary to Rush Creek, the latter being a tributary to Kings River. A truly aquatic species. July and August. Altitude about 7000 feet.

*Characteristics*.—Readily distinguished by its large lymphocytes, the shape of the lower end of the sperm-ducts and the spermatheca. The diverticles of the latter are situated much nearer the intestine than in *M. pedatus*.

#### DETAILED DESCRIPTION.

*Spermiducal apparatus*.—Atrium does not appear to possess any atrial glands. There are numerous large glands which surround the atrium but which open exteriorly to the bulb, around the latter's base. Numerous oblong and very thin penial glands inside the bulb. The bulb is small and possesses fewer muscles than most other species of the genus. On account of the insufficient fixation of the specimens the finer details of the penial bulb could not be made out as well as might be desired. The atrium is large and furnished interiorly with an epithelium consisting of large cubical cells (pl. xi, fig. 3). The funnel is large, occupying more than half of the somite when viewed in a longitudinal section of the body. When dissected it is seen that the funnel consists of three or four clefts, like those of an orange partly split open. The sperm-duct, which runs first upward, then backward, through about four somites in a more or less twisted manner, must be at least ten times as long as the funnel. The exterior papilla is quite low.

*Septal glands*.—These are large and of the same shape as in *M. pedatus*. Part of the glands adhere closely to the posterior septum

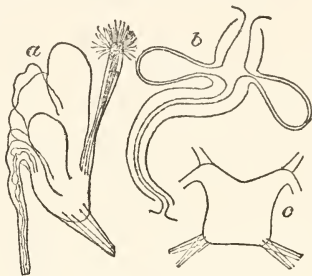


FIG. 27. *Mesenchytræus fontinalis*.



while other parts are attached to the lateral ducts leading to the pharynx.

*Esophagus* and tubular intestine throughout of very even thickness.

*Nephridia* vary considerably as regards the form of the lobes. Generally three lobes, and the whole nephridium is more or less deltoid.

*Lymphocytes*.—Unusually large (fig. 15), ovoid or even circular. In all the specimens sectioned, confined to the first thirteen somites. The diameter of an average lymphocyte equals in thickness the epithelium of the body-wall together with half the diameter of the transverse muscular layer. They are strongly granular.

### MESENCHYTRÆUS FONTINALIS GRACILIS var. nov.

Text-fig. 28.

*Definition*.—Length 5 mm., width .5 mm. Somites about 50. Spermatheca with a pair of club-shaped diverticles situated about one-third the distance from the intestine. In other respects similar to the species.

*Locality*.—In mud of springs near Dinkey Creek, in the Sierra Nevada, Fresno County, California. Altitude about 6000 feet.

*Characteristics*.—I can find no distinct characteristics other than a greater slenderness of the spermatheca and a greater equality of the two limbs. In the species the ampulla between the intestine and the junction with the diverticles is very short, much shorter than the diverticle. In the variety, the ampulla between the intestine and the junction of the diverticles is about one and one-half times as long as the diverticles, and the part between the pore and the junction of the diverticles is about two and one-half times as long as the diverticles. The diverticles also are longer in the variety than in the species. These differences may be slight, but the fact that they were found to be constant in four specimens of the variety in the six specimens of the species which I dissected shows that they are of considerable importance and worthy of being recorded.

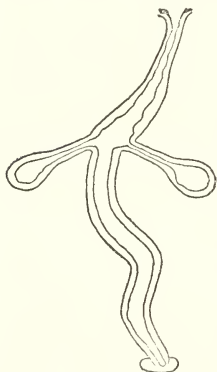


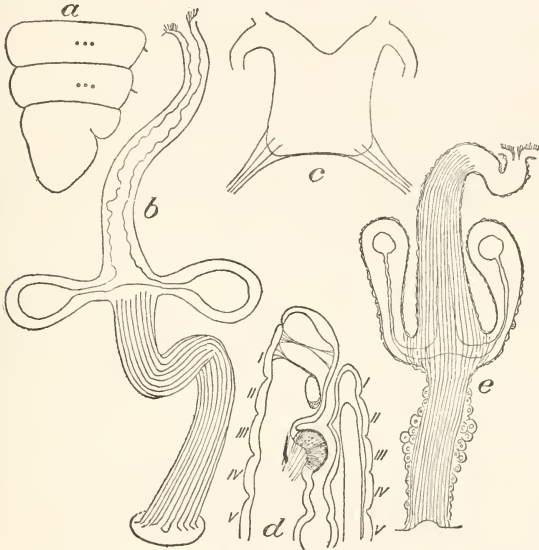
FIG. 28. *Mesenchytræus fontinalis gracilis*.



## MESENCHYTRÆUS PEDATUS sp. nov.

(Pl. I, figs. 13 and 14; Pl. IX, figs. 3-6; text-figs. 29 and 30.)

*Definition*.—Length 10 mm., width .75 mm. Somites 48. Setæ sigmoid; laterals 3-4, ventrals 5-6. Head-pore small, opening half-way between apex of prostomium and peristomium. Clitellum, dorsally  $\frac{1}{2}$  XI-XIII, ventrally XII, XIII. A very large exterior copulatory organ, almost as long as the diameter of the body. Brain anteriorly

FIG. 29. *Mesenchytræus pedatus*.

slightly concave, posteriorly with straight margin, a trifle longer than broad. Septal glands in IV, V and VI. Spermathecae each with two club-shaped diverticles situated halfway up the organ. Sperm-funnels two-thirds as long and broad as a somite. Sperm-ducts at least eight times as long as the sperm-funnel. Sperm-ducts with an atrial chamber before the penial pore. A ring of very large accessory glands open in the immediate vicinity of the sperm-ducts. Dorsal vessel originates in XIV. Nephridia with three somewhat indistinct lobes and a helix-like posterior spur. Lymphocytes of two forms, oblong and round.

*Locality*.—Found at Goose Lake, Alturas and other localities in Modoc County, California. Collected by Dr. Richard C. McGregor. Probably common in the mud of creeks and lakes in the Sierra Nevada region of northern California.

*Characteristics*.—Readily distinguished exteriorly by very large copulatory papillæ in XII, especially in specimens where they are fully extended, the papillæ then being as long as the diameter of the body. Interiorly it is prominently characterized by the enormously large accessory glands, which open in the immediate vicinity of the sperm-ducts (Pl. IX, fig. 5).

#### DETAILED DESCRIPTION.

*Setæ*.—In the first few somites the number of setæ varies between three and four in the lateral fascicles, while in the ventral fascicles we

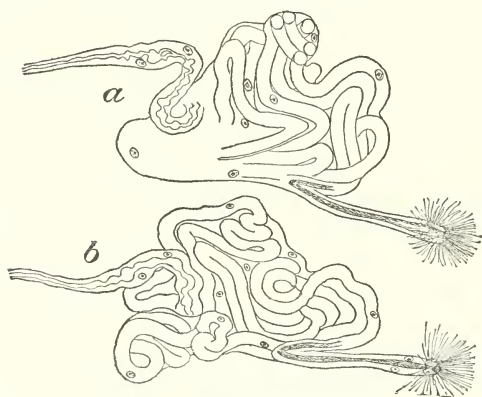


FIG. 30. *Mesenchytræus pedatus*.

find six setæ in the three anterior fascicles and five in the following. Posterior to clitellum the setæ in the ventral rows are uniformly five, while in the lateral rows they are only four. All the setæ in the same fascicle are of about the same size.

*Head-pore*.—

This pore is situated (fig. 29, a) a little in front of the shallow groove which separates prostomium from somite I.

*Spermiducal apparatus* (Pl. IX, figs. 4 and 5).—As stated, the large sexual papilla is most conspicuous. When fully extended its long diameter is equal to the diameter of the body at somite XII (Pl. IX, fig. 5). The sperm-ducts open at the apex, and this latter is surrounded by the elevated margin of the body-wall, here consisting of large broad cells. Surrounding the opening of the sperm-ducts is a small bulb, into which opens a ring of very large accessory glands. These glands extend inward to the center of the body-cavity. Their structure seems to resemble that of the septal glands. The sperm-

ducts are at least eight times as long as the funnels. The duct runs at first back for three somites, turning in XV and then paralleling itself. In XII it is coiled several times, and then, entering in XI, joins the funnel. It is, however, quite narrow, about one-sixth the width of the funnel. In longitudinal section of the body the funnel is seen to be in length two-thirds the transverse diameter of the body and about two-thirds as wide. The sperm-duct possesses an atrial chamber some little distance from the male-pore (pl. ix, fig. 5).

*Dorsal vessel* rises from the intestine in somite XIV, but does not always separate itself at once. Thus, in one specimen it was fully separated in XIV, in another in XV.

*Testes* small, solid, in XI; ovaries long, in XII. Two sperm-sacs, tubular in form, extending from XII to XV. Ovisac extends as far back as XVII.

*Spermatheca* large, each with two large club-shaped diverticles projecting from the center (fig. 29, *e*). Ampulla of the spermatheca twisted, and sigmoid where it connects with the intestine from the ventral side.

*Nephridia* (fig. 30, *a* and *b*) consist each of three more or less indistinct lobes. To these must be added a posterior helix-like spur, probably analogous with the spur in the Megadrilid genera (Eisen 16).

The tubules wide and closely wound, as in other species of *Mesenchytræus*. It is apparent that the nephridium is built somewhat as in the higher Oligochaeta, and there is possibly a 'bridge' starting out from the helix-like spur. The ducts of the spur are much thicker than those in other parts of the nephridium.

*Lymphocytes* (pl. ix, fig. 3).—Of at least three different shapes and of various sizes—round, oval, or crescent-shaped. The structure appears to be the same in all and I am unable to say whether we have three distinct forms or only variations of one and the same variety.

### MESENCHYTRÆUS BERINGENSIS sp. nov.

pl. x, figs. 1-3; text-fig. 31.

*Definition*.—Length 15 mm., width .75 mm. Somites about 70. Setæ sigmoid: laterals, 2, 2, 3, 4, 2, 3, 2, 3, 3, 0, 0, 4, 3, 3, 3, 3, 3, 3, etc., 4, 4, 4, 5, 4, 5, 5, 4, etc.; ventrals, 5, 5, 6, 7, 6, 5, 6, 7, 6, 0, 0, 4, 5, 5, etc., 5, 6, 7, 6, 5, etc. Prostomium pointed. Head-pore near apex. Clitellum, XI, XII and XIII. Sexual papillæ large. Septal glands in IV to VI. Brain tapering posteriorly; posterior margin almost straight. Dorsal vessel rises posterior to clitellum.

Intestine with very minute chloragogen cells. Spermathecæ join the intestine in V; diverticles as long as the ampullar part, club-shaped; ampulla inflated and sac-like; duct strongly muscular. Sperm-ducts narrow and probably short. No atrium exterior to the bulb. But inside the latter we find an enlargement of the sperm-duct, of similar form and structure as an ordinary atrium, but without the atrial glands. Below this enlargement there is a swelling of the walls of the duct containing a large number of thin and slender penial glands opening in the very apex of the sperm-duct. Penial bulb with numerous large glands opening around the penial pore. No accessory glands. Sperm-sacs apparently small. Lymphocytes small, ovoid, with pointed ends. Color of alcoholic specimen deep yellow, no pigment.

*Locality*.—Bering Island, Bering Strait, Alaska. Collected by Dr. Anton Stuxberg, Vega Expedition under Baron Nordenskiöld, August 15, 1879. A single specimen.

*Characteristics*.—Although the want of specimens prevents a thorough examination and leaves many points undetermined, yet the few characters known are so prominently characteristic that the species cannot be confounded with any other thus far described. The absence of both atrial and accessory glands at the same time is a rare occurrence. In many respects the structure of the efferent apparatus reminds us of *M. pedatus*. The difference between the two species is however great enough. In *M. pedatus* the large glands at the base of the sperm-duct are free and not enclosed in the bulb. In our present species these glands are entirely enclosed in the penial bulb. Neither species possesses atrial glands.

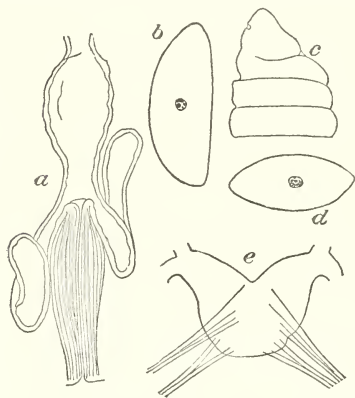


FIG. 31. *Mesenchytræus beringensis*.

#### DETAILED DESCRIPTION.

*Brain* (fig. 31, *e*).—Posterior margin almost straight, the general form of the brain rounded, as in fig. 31, *e*. In the specimen examined the two sides of the brain are somewhat unequal.

*Setæ*.—The setæ diminish slightly in size towards the dorsal and the lateral intervals respectively. No setæ in somites XI and XII.

*Spermatheca* (fig. 31, a).—The ampulla connects with the intestine in V and is considerably swollen, furnished with thin walls. The duct muscular, exterior surface striped longitudinally.

*Sperm-ducts*.—As the specimen was sectioned transversely the size of the funnels is not known. The sperm-ducts narrow, apparently not very long, repeatedly folded. The atrium and the penial chamber of nearly equal size, the atrium slightly the larger. The absence of atrial glands a distinct feature. In the penial chamber some few glands opening independently of each other around the pore of the duct, enclosed by the muscular coat of the lower part of the sperm-duct. The penial glands are powerfully developed and crowd the bulb to the utmost. Between the glands are muscles and connective tissue.

The *nephridia* were too macerated to be described satisfactorily.

### MESENCHYTRÆUS SOLIFUGUS Emery.

Pl. VII, fig. 8; Pl. VIII, figs. 1 and 2; text-fig. 32.

1898. *Melanenchytræus solifugus* EMERY, '98.

1899. *Mesenchytræus solifugus* MOORE, '99.

*Definition*.—Length 12 mm., width .5 mm. Somites about 50. Setæ: anteriors about 4, 5, 3; posteriors, 2, 3, etc. Prostomium rounded, blunt and small. Clitellum probably confined to XII. Sexual papillæ prominent. Septal glands small. Spermatheca straight, with three diverticles in the same plane at the center of the organ. Sperm-ducts comparatively broad, extending at least as far back as XV and probably farther. Funnels cylindrical, folded on themselves, contracted at the center. A large atrium in which opens about eight atrial glands of large size. Many large accessory glands open along the base outside of the penial bulb. About fifteen penial glands inside the penial bulb. Nephridia with three large lobes and a long anteseptal. Lymphocytes small, pointed, ovoid. Color intensely brownish-black owing to pigment which permeates most of the inner organs as well as the body-wall.

*Locality*.—Occurs on the ice of many of the glaciers of Alaska. Collected by Prof. Trevor Kincaid and Prof. W. E. Ritter on the following glaciers: Muir Glacier, June 11; La Perouse Glacier, June 18. Specimens have also been described by Prof. J. Percy Moore from the Malaspina Glacier.

*Note*.—Professor Moore partly describes another ice worm, *M. niveus* Moore, from the Malaspina Glacier, said to differ in havng

posteriorly emarginated brain and in not possessing any diverticles of the spermathecæ. This species is not among those collected by the Harriman Expedition, at least none of those examined by me possessed these characters.

The above definition had already been made out when I received the admirable description of the species by Professor Moore (Proc. Philadelphia Acad. Sci., 1899). This description is so full that few details need be added.

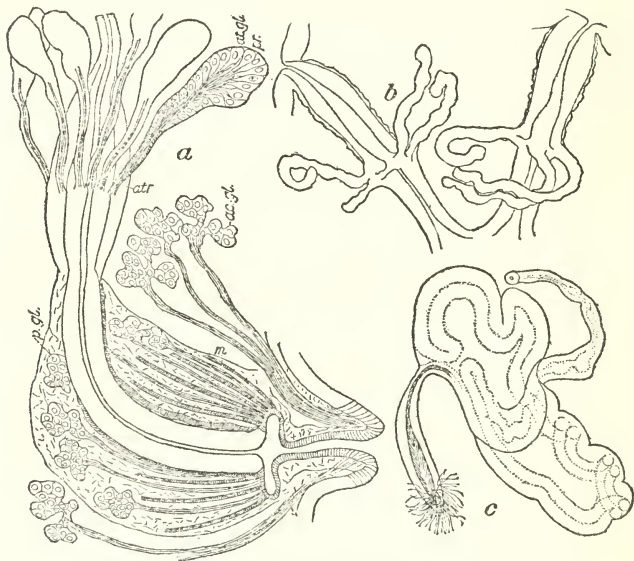


FIG. 32. *Mesenchytræus solifugus*.

*Color*.—The object of the deep color is probably not alone to absorb heat, but also to exclude light. The worm breeds under the exposure to constant daylight, and the pigment must admirably serve the purpose of modifying this light. All other Enchytræidæ can hide themselves under opaque substances, but this ice worm has no place to hide, as the snow and ice are comparatively transparent. The pigment is distributed not only in the body-wall, but in most of the interior organs, even in the ganglia and the brain.

*Spermiducal apparatus*.—The accessory glands, which are characteristic, open along the base of the penis outside of the bulb. They are long and of trefoil shape, with enormous long narrow ducts.

It is not impossible that the various glaciers of Alaska contain several species of black ice worms, and it would be of the greatest interest to have these worms carefully collected and fixed so that they could be readily investigated. Most of the specimens in the collection were in a state of decomposition, and it is evident that these worms are extremely sensitive to heat and should be fixed on the spot where collected without first being brought to the laboratory.

#### Subfamily *ENCHYTRÆINÆ*.

This subfamily contains only two genera, both of which are certainly closely related. In this family the penial glandular structures are not confined within a single bulb as in *Lumbricillinae*, but are broken up in two or more masses of papillæ, often of unequal size. In a cross-section of the body these papillæ may be seen to extend from the median line to the other side of the spermiducal pore, and even in the long diameter of the body the glands have a more or less considerable extension. In some species these glands are situated close to each other, in others again they are separated by the common tissue of the body-wall.

#### Genus *Enchytræus* Henle.

*Definition*.—Setæ of equal length and straight. Head-pore between prostomium and somite I, always small. No dorsal pores anterior to clitellum. Intestine and esophagus gradually merging into each other. Dorsal vessel rises posterior to clitellum from a vascular sinus of the intestine. One pair of sperm-sacs, surrounded by peritoneal membrane, project from the testes forward. No single penial bulb, but one or more isolated glandular papillæ situated in the vicinity of the spermiducal pores, generally and principally ventral to the pores. Numerous transverse muscles connect the ventral and lateral parietes surrounding the spermiducal pores. Peptonephridia glands present or absent. One kind of lymphocytes. Intestine generally with chylus cells.

As will be seen from the above definition, I have added some characteristics not mentioned by Michaelsen and Beddard. One of these concerns the presence of sperm-sacs. There can be no doubt about the presence of sperm-sacs, just as perfectly developed, though not as large, as those in *Mesenchytræus*. In all the species examined



by me such sperm-sacs are present, but vary greatly in size. In *Enchytræus saxicola* they are enormously large, extending as far forward as the spermathecæ. There are, however, no trabecula, at least not in the species which were sectioned. Michaelsen mentions the presence of sperm-sacs in *Enchytræus mæbii* (4), but does not use their presence as a generic characteristic.

Another characteristic relates to the transformation of the penial bulb into separate papillæ surrounding the lower part of the sperm-duct. Such papillæ are found in all other Enchytræid genera which I have investigated, or which I have seen illustrated. In *Enchytræus* the spermducts open independently of any glands. There are however glandular complex in the vicinity of the spermiducal pores in several of the species, and perhaps in all, but they are situated some little distance from the lower part of the sperm-duct, or if close, are still distinctly separated from them. At any rate the sperm-ducts are never directly connected with any glands or ducts of glands, but open independently of any accessory structures through the body-wall.

#### DETAILED DESCRIPTION.

*Brain*.—The brain in *Enchytræus* is characterized by the circular mass of fibers in the posterior part of the fiber belt in the brain. As this structure has not been studied in detail its nature is not understood.

*Nephridia*.—Characterized by the small anteseptal which consists merely of the nephrostome. A similar arrangement is found in *Lumbricillus*. In no instance is there an anteseptal resembling that found in *Fridericia*.

*Penial papillæ and structures*.—No penial bulb similar to the one found in *Fridericia*, *Lumbricillus*, etc. The sperm-ducts always open separately from the glandular masses, which are found in the vicinity of the ducts. These glands are never surrounded by a special muscular covering, but seem to be more intimately connected with the epidermis, and as such covered by the general muscular layers of the body. In some species we meet with a great number of slightly separated glandular cushions, each consisting of many glandular cells arranged in a pinnate or feathery manner, but all these cells open some little distance from the sperm-ducts. In other species there are only a very few such cell agglomerations. Now and then a muscular strand may be seen to penetrate between the cells down to the body-wall. The muscular penial bulb in other genera is in *Enchytræus* separated by a number of isolated muscular strands, which connect the body-wall in the vicinity of the penial pore with the parietes higher up along the sides of the body.



## SYNOPSIS OF SPECIES OF ENCHYTRÆUS DESCRIBED IN THIS PAPER.

## I. SPERMATHECA WITHOUT DIVERTICLES.

Spermatheca more or less covered with small glandular cells. No distinct and enlarged pouch.....1. *E. modestus* sp. nov.

Spermatheca short and thick, with a large collar of glands at the base. Spermathecal connection with the intestine is situated on the side of the spermatheca. Two large glandular penial papillæ at the penial pore.

2. *E. metlakatlensis* sp. nov.

## II. SPERMATHECA WITH A SINGLE DIVERTICLE.

Spermatheca short and thick. The connection with intestine is situated on one side of the spermatheca. Two separate penial papillæ near the spermiducal pore. A few small glands around the base of the spermatheca.

3. *E. kincaidi* sp. nov.

## III. SPERMATHECA WITH TWO DIVERTICLES.

Spermathecal diverticles distinct, both of the same size. Stalk of spermatheca longer than the ampulla. A large number of penial papillæ near the spermiducal pore covered by the regular muscular layer of the body.

4. *E. alaskæ* sp. nov.

Spermathecal diverticles of unequal size. Brain deeply emarginated posteriorly. Sperm-funnels very long and narrow. Penial papillæ two, and very minute, situated close to the spermiducal pore....5. *E. saxicola* sp. nov.

Spermathecal diverticles unequal in size. Brain posteriorly convex. Sperm-funnels short and twisted. Two small penial papillæ near the pore.

6. *E. citrinus* sp. nov.

## ENCHYTRÆUS MODESTUS sp. nov.

Pl. XIX, figs. 2 and 3; text-fig. 33.

*Definition.*—Length 6 to 7 mm., width .4 mm. Somites 57, pluri-ringed. Prostomium pointed, about one-third shorter than somite I. Intersegmental grooves deep. Setæ straight and of equal length, three in each fascicle, dorsal as well as ventral. Brain posteriorly almost straight, the posterior retractor muscles much narrower than the lateral ones. Dorsal vessel rises posterior to clitellum (undeveloped in the specimens). Spermatheca without diverticles, straight and more or less warty, not

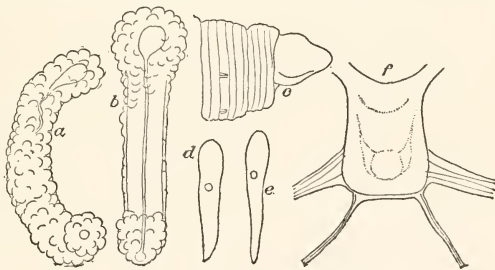


FIG. 33. *Enchytræus modestus*.

connecting with the intestine. Nephridia with exceedingly narrow inner duct filling only a small part of the nephridium; the anteseptal

consists of little more than the nephrostome. Lymphocytes narrow, long, and rather irregular. Color white.

*Locality*.—Orca, Prince William Sound, Alaska, June 25, 1899, Prof. Wm. E. Ritter. Only three immature or degenerating specimens, so much twisted and curled that no successful sectioning could be made.

#### DETAILED DESCRIPTION.

Few additional points can be given. The species seems well characterized by its nephridia, the inner duct in which is narrower than in any other species examined by me.

*Sexual papillæ*.—The male pores sunk in the specimens; no external penial papillæ. The inner penial papillæ constructed on the same principle as in the other species described in this paper; that is, there is a set of glands grouped in bunches arranged like feathers, between which opens independently the sperm-duct. The particular arrangement could not be made out.

*Spermiducal apparatus*.—The ducts seem to be short and rather thick.

*Intestine* is covered by a thick layer of closely set, but transparent and non-staining chloragogen cells.

*Lymphocytes*.—There is a cyanophil stroma in the meshes, in which there are a few, or comparatively few, eosinophil granules. The nucleus is small but distinct, staining pale blue.

#### ENCHYTRÆUS METLAKATLENSIS sp. nov.

pl. xviii, fig. 5; pl. xix, fig. 1; text-figs. 34-36.

*Definition*.—Length 12 mm., width .65 mm. Somites 60. Setæ: laterals 3 and 2; ventrals 3 and 4 in each fascicle. Prostomium rounded, blunt. Clitellum XII and XIII. Sexual exterior papillæ small and not prominent. Septal glands in IV, V and VI. Brain oblong, posteriorly slightly emarginated. Dorsal vessel rises in XV. Intestine gradually emerging in the esophagus. Spermathecæ with short and thick duct and with a short apical sac opening into the intestine by a pore; a collar of glands at the base surrounds the exterior pore. Sperm-ducts long and narrow, closely coiled, confined to XII. Sperm-funnels short and thick, bent on themselves. Penial papillæ two, between which open the sperm-ducts. Penial papillæ consist of about 6 lobes in each papilla, the anterior and posterior papillæ being of about equal size. Ovaries in XII, testes in XI. Testes each connected with a sperm-sac which, penetrating the septum, projects into X, filling a large part of the somite. The sperm-sacs are surrounded by a cœlomic membrane. Lymphocytes long and narrow, shuttle-like or

elongated ovoid, with the apices sharply pointed. Nephridia with a small anteseptal consisting of nephrostome; the duct is strong, with a lumen much wider than that of the main body of the nephridium; the duct in the main body tightly and apparently irregularly folded.

Color gray.

*Locality*.—Metlakatla, Alaska, June 4, 1899. Found under sea-weeds, by Prof. W. E. Ritter.

*Characteristics*.—The contracted spermathecæ are characteristic of this species. Another point of distinction between this

species and *Enchytræus alaskæ* is seen in the two penial papillæ, which are of equal size and further apart than in the present species.

*Brain*.—The structure of the brain offers some points of interest. The fibers, which in other genera form a solid convex band, are in

this, as well as in *E. alaskæ*, broken up into two groups, one forming a globular projection extending further back toward the posterior margin (fig. 34, *b*). It is not improbable that this peculiarity is of generic importance.

*Intestine*.—There is a thin coating of broad chloragogen cells in somites VI to IX; in the other somites no such cells can be seen.

*Spermathecæ* (fig. 36).—The pore connecting with the intestine is not at the apex of the pouch, but situated on one side, as shown in fig. 36.

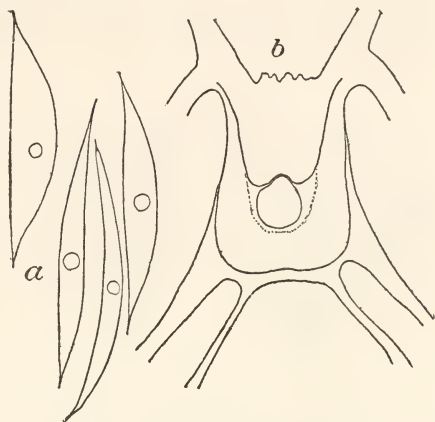


FIG. 34. *Enchytræus metlakatlensis*.

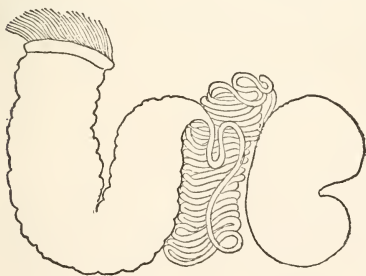


FIG. 35. *Enchytræus metlakatlensis*.

*Penial glands*.—In a longitudinal section two separated bunches of glands forming two separate papillæ, one situated in front of the other. Both bunches of equal size, but not strictly in the same plane. As there were no specimens to spare for cross-sectioning, it was not

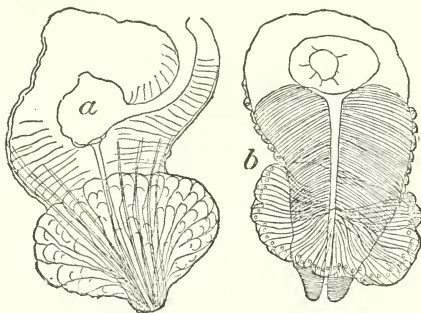


FIG. 36. *Enchytræus mellakatlensis*.

possible to ascertain the whole extent of the glandular structure. The sperm-duct penetrates the body-wall between the two glandular papillæ, but there are no glands entering the ducts.

*Nephridia*.—These organs show great similarity to those of *E. mæbii* Mich., as well as to those of *E. alaskæ*.

The duct connecting with the nephropore wide, becomes narrow only when it joins the main body of the nephridium. The inner duct is coiled in such a manner that it is impossible to follow its windings for any distance.

*Lymphocytes* (fig. 34, a).—These long and unusually narrow bodies are present in considerable numbers. They attach themselves everywhere by means of their pointed ends.

*Sperm-sacs*.—There is no doubt about the presence of a cœlomic membrane surrounding the developing spermatozoa, thus constituting a regular sperm-sac. Where the sac penetrates the septum X/XI a few trabeculæ are seen to extend forward through the mass of developing spermatogonia.

### ENCHYTRÆUS KINCAIDI sp. nov.

Pl. XVIII, figs. 2-4; text-figs. 37 and 38.

*Definition*.—Length 20 to 25 mm., width .75 mm. Somites about 67. Setæ: anterior ones slightly more slender than the posterior ones; laterals, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 2, 2, 2, 2, 2, etc.; ventrals, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 0, 2, 2, 2, etc. Other specimen: laterals, 3, 3, 3, 4, 4, 4, 4, 3, 3, 3, 2, 2, 2, 2, 2, etc.; ventrals, 3, 3, 4, 4, 4, 3, 3, 3, 3, 0, 0, 3, 2, 2, 2, etc. Body-wall transparent. Prostomium blunt, rounded, intersegmental grooves shallow. Cli-

tellum with thin walls XII and XIII. Sexual papillæ not present. Septal glands in IV, V and VI; those in IV the smallest, and those in VI the largest. Peptonephridia consist of one or two short and broad twisted lobes. Brain longer than broad, posteriorly distinctly convex. Dorsal vessel rises in XVI. Intestine without chloragogen cells. Spermathecæ short and thick, with one diverticle at the inner apex; the main body connects at its center with the intestine. Spermatheca narrow, coiled, confined to XII. Funnels large, three times as long as

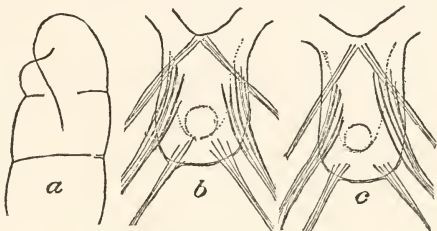


FIG. 37. *Enchytræus kincaidi*.

broad. Penial inner papillæ two, the posterior one the largest; the cells with a feathery and radiating arrangement. Spermatheca: one pair connected with the testes, projecting forward into somite X; no trabecula present. No ovisacs. Nephridia with anteseptal consisting only of nephrostome; duct thin and much coiled. Lymphocytes broad, irregularly ovoid, not large, cyanophil, without eosinophil granules. Color white, body entirely transparent.

*Locality*.—Popof Island, Alaska, Prof. Trevor Kincaid. Under rocks on the shore. Several specimens in very fine condition.

*Characteristics*.—As usual the form of the spermathecæ is the most characteristic feature.

#### DETAILED DESCRIPTION.

*Setæ*.—The setæ straight with the basal part considerably curved. All in the same fascicle of the same or nearly the same length; no one decidedly longer than the rest.

*Clitellum*.—The wall of the clitellum not more than twice as thick as the general body-wall. Even the body-wall unusually thin.

*Brain* (fig. 37, *b*).—Brain as in the other species of this genus described in this paper. A circular mass of fibers at the apex of the inner fiber curve.

*Spermathecæ*.—Several specimens dissected; spermathecæ found to vary but little in form. The lower end furnished with a set of glands near the pore, the glands opening into the duct. The connection with the intestine at the center of the whole organ. A short and thick diverticle points upward and forms the inner apex of the organ.

*Sexual glands.*—The penial papillæ on each side consist of two distinct and separate masses of glandular cells arranged in the usual feathery manner characteristic of this genus. There are two agglomerations of such glands, one anterior to the other, the anterior one being the smallest. In the specimen sectioned longitudinally the former gland-complex is seen to consist of eight agglomerations, while

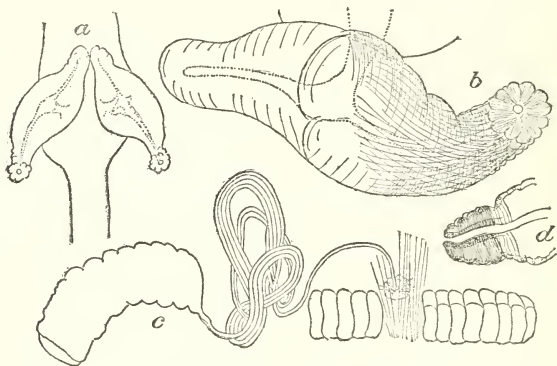


FIG. 38. *Enchytræus kincaidi*.

the latter or anterior one contains only three or four. There is, however, some variation, as in one dissected specimen the anterior complex is only one-third smaller than the posterior one. The sperm-funnels are somewhat curved and about three times as long as wide. *Sperm-ducts* open independently of the penial papillæ and a little more ventrally than either.

*Nephridia.*—The inner duct narrow, running in a zigzag manner. Sections show that the lumen is connected with innumerable minute and probably branching ducts, too small to be indicated on the figure (pl. xviii, fig. 3).

#### ENCHYTRÆUS ALASKÆ sp. nov.

Pl. I, fig. 19; Pl. XIX, figs. 4-6; Pl. XX, figs. 1-2; text-figs. 39 and 40.

*Definition.*—Length 15 mm. or less, width .75 mm. Somites 65, strongly tapering toward the tail end. Prostomium rounded; somite I smaller than II or III. Head-pore between prostomium and somite I. Setæ straight: anterior laterals 3, posterior 2; anterior ventrals 3, posterior 2 and 3. Sexual papillæ not prominent. Clitellum

distinct, XI to XIII, saddle-shaped. Septal glands in IV, V and VI. Peptonephridia short and undivided. Brain posteriorly slightly concave, oblong. Dorsal vessel rises in XV, but separates only in XII. Esophagus gradually emerging in the sacculated intestine. Spermathecae with long stalk and a lopsided ampulla connecting with the intestine. Sperm-funnels short, bent. Sperm-ducts narrow, coiled, in XII and XI, opening on the side of small penial papillæ. A pair of large interior penial papillæ near the male pores. Nephridia large, rounded, with granular neck and greatly coiled duct. Anteseptal consists merely of the nephrostome. Lymphocytes of two forms, rounded-oval and tapering. Both are erythrophil. Color white.

*Locality*.—Garforth Island, Muir Inlet, Glacier Bay, Alaska, June 9, 1899, Prof. W. E. Ritter.

#### DETAILED DESCRIPTION.

*Penial interior papillæ*.—The most interesting features of the species of this genus are the structure of these organs. The penial interior papilla is in itself very small, and consists of two unequal papillæ, between which the sperm-ducts open. The smaller is situated close to the body-wall (Pl. XIX, fig. 4), while the larger is situated nearer the ventral ganglion. The sperm-ducts open between these two papillæ. There are numerous muscles between the two papillæ as well as between the sperm-duct and the papillæ. The papillæ contain only one kind of glands, which do not open into any lumen, but onto the exterior surface of the body. No glands open into the sperm-duct. Besides these comparatively small penial papillæ we find located more centrally two larger penial papillæ close to the ventral ganglion (Pl. XIX, fig. 6). In a transverse section of the body of the worm these penial papillæ are not cut at the same time as the other penial papillæ, the latter being situated a little anterior to the former. The penial papillæ are all of the same general structure and contain a number of unicellular glands arranged in many isolated bunches, each bunch opening separately from the other. Between these papillæ are



FIG. 39. *Enchytræus alaskæ*.



seen a number of smaller glandular papillæ in a continuous row across the somite. Somewhat similar structures have been figured by Michaelsen for *E. mæbii*, and I contend that they are characteristic of this genus.

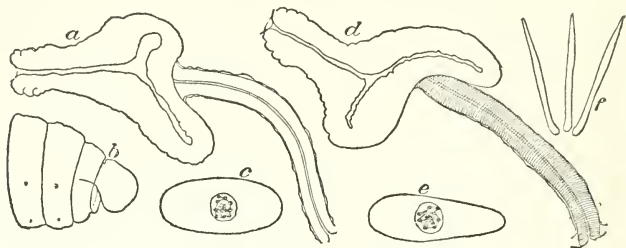


FIG. 40. *Enchytræus alaskæ*.

### ENCHYTRÆUS SAXICOLA sp. nov.

Pl. XVIII, fig. 6; text-fig. 41.

*Definition.*—Length 15 to 20 mm., width .65 mm. Somites 63. Body transparent, with thin walls. Prostomium blunt and rounded. Head-pore between prostomium and somite I. Setæ straight: laterals, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 2, 2 (15 somites), 3, 3, 3, 3, etc.; ventrals, 3, 3, 3, 3, 3, 3, 3, 3, 3, 4, 0, 2 (12 somites), 3, 3, 3, etc. Clitellum

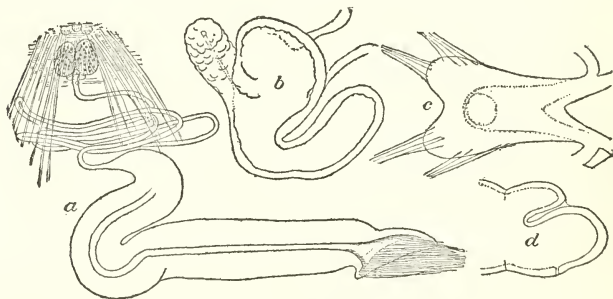


FIG. 41. *Enchytræus saxicola*.

XII and XIII, prominent. No external sexual papillæ. Brain posteriorly deeply emarginated, longer than broad. Dorsal vessel rises posteriorly. Intestine much narrower in somites VII to X. Spermathecæ short and thick, each with a single diverticle; connects centrally



with the intestine in V; duct short and narrow. Sperm-ducts narrow, a few times longer than the funnel, which is long and narrow, with the basal part sigmoid. A minute penial papilla situated ventrally and close to the spermiducal pore. The sperm-ducts open independently of these glands. One pair of long cylindrical sperm-sacs extend from the testes forward through somites X to VII. No ovisacs. Nephridial anteseptal consists of only the nephrostome. Lymphocytes of medium size, thicker at one end, strongly granular. Color transparent white.

*Locality*.—Lowe Inlet, British Columbia, June 3, 1899, Prof. Trevor Kincaid. "Under rocks at high tide."

*Characteristics*.—This species undoubtedly stands near *E. kincaidi*, but differs not only in the form of the spermathecæ, but also in the emarginated brain, and in the presence of only one small penial papilla near the pore of the sperm-duct.

#### DETAILED DESCRIPTION.

*Brain*.—The longitudinal diameter is about twice as long as the transverse one. There is a central circular and somewhat globular mass of fibers in the fibrous band.

*Spermathecæ*.—The diverticle is wide, in one spermatheca entire, in the other indistinctly lobed, forming chambers containing balls of spermatozoa. The duct resembles that of *E. kincaidi*; the diverticle wider than in that species. The connection with the intestine at the center and at one side of the organ.

*Sperm-funnels*.—One of the funnels somewhat shorter than the other. The longest funnel is represented by the figure (41, *a*).

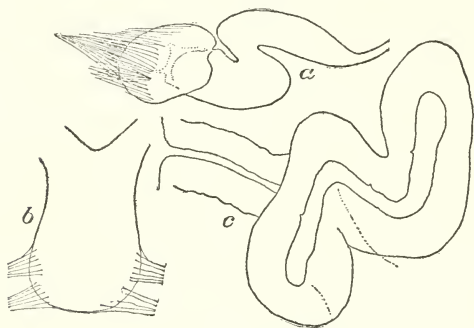
*Spermiducal pores*.—As in other species of this genus described in this paper, no trace of any penial bulb. The sperm-ducts open independently of any glands. A small penial papilla close to the pore, situated more ventrally. It contains two minor gland agglomerations situated side by side, and two or three smaller ones situated nearer the ganglion. As a substitute for a penial bulb there are numerous muscle fibers connecting the ventral and dorsal parietes around the spermiducal pore, just as in the higher Oligochæta, as for instance in *Pontodrilus*.

*Sperm-sacs*.—They consist of two very large bodies surrounded by a peritoneal membrane of great toughness. They fill entirely somites VIII to X, and encroach upon VII. The intestine is quite narrow in the somites occupied by the sperm-sacs. The sperm-sacs are slightly contracted by the septa. Compared with the sperm-sacs of *E. kincaidi*, those of the present species are two or three times as long, but not quite so wide. They are readily dissected out without breaking.

## ENCHYTRÆUS CITRINUS sp. nov.

Text-fig. 42.

*Definition.*—Length 17 mm., width .5 mm. Somites 50. Pro-stomium blunt. Setæ: laterals, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 2 (for 11 somites), 3, 3, etc.; ventrals, the same as the laterals, except 0 in XII. Clitellum XII–XIII. No sexual papillæ exteriorly. Brain slightly longer than broad, posteriorly convex. Dorsal vessel rises posteriorly (probably in XVI). Blood deep lemon-yellow. Intestine narrower in somites VIII to X. Spermathecae with large and thick apical

FIG. 42. *Enchytræus citrinus*.

ampulla and a distinct and strong duct. Sperm-ducts about three times as long as the funnel. The funnels rather short, sigmoid. Two very minute internal penial papillæ close to and a little ventral to the spermiducal

pore. Lymphocytes of medium size, ovoid, tapering toward one end. Nephridia similar to those of *E. saxicola*. Color deep lemon-yellow.

*Locality.*—Lowe Inlet, British Columbia, Prof. Trevor Kincaid, June 3, 1899.

*Characteristics.*—There is considerable doubt whether this form should be arranged as a distinct species or considered a variety under *E. saxicola*. While it is true that the spermathecae are somewhat larger and slightly different in shape, the main distinction between the two species lies in the shape of the brain and in the color of the blood. The specimens of both *E. saxicola* and *E. citrinus* were transmitted to me in the same bottle and had been collected at the same place and preserved in formalin in the same manner. Still in *E. citrinus* the blood was deep yellow, while in *E. saxicola* it was white or uncolored. The brain in the two species is distinct in shape.

*Spermiducal apparatus.*—Funnels smaller than in *E. saxicola*, the two small inner papillæ close to the spermiducal pore more minute

than in that species. Two large sperm-sacs extending through several somites anterior to XI. In shape these sacs resemble those of *E. saxicola*.

Genus *Michaelsena* Ude (part).

*Definition*.—Setæ straight, more or less absent in majority of the somites. Head-pore between prostomium and somite I. No dorsal pores. Esophagus gradually merging into the intestine. Dorsal vessel rises posterior to clitellum, and is without cardiac gland. No peptonephridia. Testes solid. Nephridia as in *Enchytræus*. Penial papillæ without interior muscular strands. No penial bulbs.

To the definition given originally by Ude I have added the characteristics of the penial bulb, and modified that referring to the setæ. It is to my mind evident that if we are to recognize the genus *Michael-sena* we must make the definition wide enough to include both Michaelsen's species, *Enchytræus monochaetus*, and my new species, *Michaelsena paucispina*. These species differ but slightly from *M. subtilis* Ude, the differences referring only to the number of missing setæ. In *M. paucispina* the setæ are entirely absent on the anterior three somites, and in all the other anterior somites only two ventral setæ are found in each somite. In some of the posterior somites there are four setæ in each somite. In *Enchytræus monochaetus* a further reduction has taken place, as there are no setæ in the anterior five somites. Then follow other somites with only ventral setæ, while the majority of somites seem to possess four rows of single setæ. In *M. subtilis* another step in the reduction has been taken, and we find in this species only ventral setæ in somite IV, V and VI. In all the other somites the setæ are absent. I cannot see how we could very well include one of the above species in the genus and exclude the others. So far as known there are no characteristics of sufficient importance to separate these three species in different genera.

#### SYNOPSIS OF SPECIES.

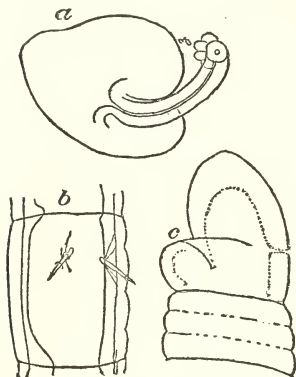
1. *Michaelsena subtilis* Ude. Setæ found only in somites IV, V and VI, and here only two pairs corresponding to the ventral fascicles. Size 5 to 6 mm.
2. *M. monochaeta* (Michaelsen). The anterior four or five somites without any setæ. The following few somites possess only single ventral setæ, while all the other somites possess four single seta, each setæ corresponding to single fascicle. Length 7 mm., width .25 mm.
3. *M. paucispina* sp. nov. Somites I, II and III without setæ. All other anterior somites with two ventral setæ, each seta corresponding to a fascicle. The posterior somites with four setæ each, each seta corresponding to a fascicle. Length 7 mm., width .2 mm.

It may be noted that all the three species seem to be marine forms, occurring along the seashore among seaweeds.

## MICHAELSENA PAUCISPINA sp. nov.

Text-fig. 43.

*Definition.*—Length 7 mm., width .2 mm. Somites 45. Setæ absent in somites I to III; in somites IV to XIII no lateral setæ present, but each of these somites, except VIII and XII, possesses two ventrally located setæ, each corresponding to the ventral fascicles. Commencing with somite XIV, all the posterior somites contain 4 setæ each, each seta corresponding to a ventral or lateral fascicle. In

FIG. 43. *Michaelsema paucispina*.

the last quarter of the body the setæ gradually increase in size in such a manner that the setæ in the last ten somites are twice as thick and a trifle longer than the anterior setæ. Setæ are straight, pointed with a swelling at the center. Prostomium large, rounded. Head-pore small, between prostomium and I. Septal glands in IV to VII. Dorsal vessel seems to rise in XV. Clitellum distinct, in XII and XIII. No sexual papillæ. Color pale yellow.

*Locality.*—Santa Barbara, California (seashore), Prof. H. P. Johnson of the University of California. A single specimen, preserved on a microscopical slide.

*Characteristics.*—The nature of the single specimen did not allow any dissection, and it was thought best not to attempt sectioning. This explains the want of knowledge of any of the interior structures. The species differs from *M. monochæta* Michaelsen by its lighter color and by the absence of lateral setæ in the somites anterior to clitellum. The two species are, however, most closely related.

*Spermatheca.*—Judging alone from optical view of the body, the spermatheca appears to possess a long narrow duct, at the base of which are a few glands. The ampulla seems to be very large and deltoid, projecting downward somewhat in the manner represented in the figure. No other details can be added.

## Subfamily LUMBRICILLINÆ.

With the exception of *Stercutus* and *Bucholzia* the structure of the penial bulb is rather uniform and varies but little in the various genera.

In the two genera mentioned the structure is not known, and these genera are only placed in this subfamily on account of their similarity in other respects to the better known genera. The variability of the structure of the setæ is best known in *Bryodrilus* and *Henlea*, where some species possess straight setæ while in others they are curved. The genus *Henlea* is particularly variable, containing species in which the setæ resemble all the three forms — Lumbricillide, Enchytræide and *Fridericia*.

#### Genus *Lumbricillus* Oerst.

*Definition.*—Setæ sigmoid, arranged in fan-shaped fascicles. Head-pore small, situated between prostomium and peristomium. Brain generally deeply emarginated posteriorly. Ventral sexual glands around the ventral ganglion generally present. Blood red or yellow. Dorsal vessel rises posterior to clitellum. No cardiac gland. No peptonephridia. Testes multi-lobed, each lobe capped by a small sperm-sac. Sperm-ducts comparatively narrow. Penial bulb without inner muscular strands, containing only numerous glands of various kinds, some of which may open into the basal part of the sperm-duct. No atrium and no glands outside of the penial bulb. Nephridia with entire postseptal and with an anteseptal which consists merely of the nephrostome.

To the definition of this genus by Michaelsen I have added the points concerning the testes and the nephridia. The fact that the testes are capped by small sperm-sacs has, I believe, not been previously noted. The small anteseptal, consisting of only a nephrostome, is probably characteristic of this genus, though it is also found in some other genera.

#### DETAILED DESCRIPTION.

*Nephridia.*—The nephridia in *Lumbricillus* are quite distinct as regards the anteseptal part. In all the species which I have investigated, as well as in all which I have seen figured, the anteseptal part consists of merely the nephrostome. The postseptal is divided into two parts, the lobe and the duct. The lobe is generally, if not always, broad and disc-like and the duct is short. The postseptal lobe is frequently furnished with granules or with bladder-like elevations near the anteseptal. In the majority of species of Marionina the anteseptal is large, resembling the *Fridericia* and *Henlea* type, while the *Lumbricillus* type is also seen in *Enchytræus*. Even the postseptal part of the Eumbricillide nephridium is characterized by its flatness and by its more or less circular outline.

*Penial bulb.*—The penial bulb in *Lumbricillus* differs in structure from that of *Mesenchytræus* and *Enchytræus*, but resembles that found in the other genera so far as known. The bulb consists of an exterior capsule of muscle strands. Inside the capsule we find one or more kinds of glands, which radiate from the base of the bulb towards the periphery. These glands are all single cells, each one of which is separate from those nearest, each one opening separately around the penial pore. Some species possess glands which open in the lower part of the sperm-duct, inside the bulb and close to the pore (Pl. XIII, fig. 1). It is probable that this latter structure may be found in all the species, and that it is characteristic of the genus.

*Sperm-sacs and testes.* — As has been already stated in a previous paper (Eisen 1900), each separate lobe of the testes is capped by a small sperm-sac. This arrangement is also found in *Ocnerodrilus occidentalis*, but not in the other species of *Ocnerodrilus*, which led me to separate *O. occidentalis* as a special subgenus. The testes in the various species differ from each other to some extent, but not sufficiently to furnish species characteristics of any practical use. The spermatogonia of the testes separate and fall into the small sperm-sacs and there undergo their further development into spermatozoa. Spermatophores are not known in this genus.

#### SYNOPSIS OF SPECIES OF LUMBRICILLUS DESCRIBED IN THIS PAPER.

##### I. SPERMATHECA WITH A SINGLE ROSETTE OF GLANDULAR CELLS AT BASE.

These cells do not extend upward on the stalk or on the main part of the spermatheca, but enter the lower part of the spermatheca about ten to fifteen cells high.

The lower half of the spermatheca enlarged and pouch-shaped. Ventral glands in XIV and XV, ventral and slightly lateral..... 1. *L. santæclarae* sp. nov.

##### II. SPERMATHECA COVERED WITH GLANDS ALONG THE ENTIRE LENGTH OF THE DUCT, BESIDES POSSESSING A ROSETTE OF GLANDS AT THE BASE.

Brain distinctly emarginate posteriorly. Spermatheca with a distinct narrow duct uniting the ampulla with the pore. Glands covering the duct increasing in length toward the base. Ventral glands in XIV, XV, XVI, and XVII, the glands of equal size..... 2. *L. merriami* sp. nov.

Brain truncate posteriorly. Spermathecal duct long, but the ampulla very small and hardly differentiated exteriorly. Ventral glands of large size in XIV, XV, XVI, XVII, XVIII and XIX..... 3. *L. annulatus* sp. nov.

Brain emarginated posteriorly. Spermathecal ampulla large, with a distinct duct leading to the pore. Glands covering the duct of even size, not broader toward the base. Ventral glands in XIII, XIV, XV, XVI, and XVII. Nephridia with glandular zone near the nephrostome...4. *L. ritleri* sp. nov.

##### III. SPERMATHECA WITHOUT DISTINCT GLANDULAR COLLAR AT BASE, but with a continuous covering of glands from top of duct to base, the glands gradually increasing in size toward the base.

Spermathecal ampulla globular. Ventral glands in XIV, XV, and XVI, increasing in size posteriorly; ventral, lateral, and dorsal.

5. *L. franciscanus* sp. nov.

## LUMBRICILLUS SANTÆCLARÆ sp. nov.

pl. XIII, figs. 3 and 4; text-figs. 44-46.

*Definition.*—Length 8 to 12 mm., width .5 mm. Somites about 50. Setæ slightly sigmoid, averaging one more in the ventral than in the lateral fascicles. Ventrals 6, 8, 7, 6, 5, 4, 3; laterals 6, 7, 6, 6, 4, 3, 3. Head-pore large, between prostomium and somite I. Head blunt and rounded. Clitellum not prominent, XII and XIII. Copulative papillæ small. Septal glands thick and compact, septal part about equal to interseptal part. Brain about 30 units long and 12 units broad (at center), and strongly emarginated posteriorly. Dorsal vessel rises in XIV. Intestine gradually widening. Spermathecae with a thick duct distinct from the ampulla. A thin ring of glands at the base of the duct. Sperm-ducts thin, confined to somite XII. Sperm-funnels slightly more than three times as long as wide, curved. Penial bulb round, small. Testes multi-lobed. Ovisac not extending posterior to clitellum. Ventral glands in XIV and XV. Nephridia thick, with a minute anteseptal and a thick postseptal from the posterior end of which the thick duct projects.

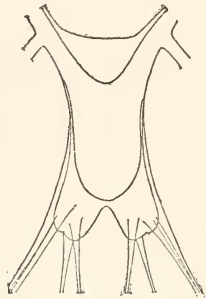


FIG. 44. *Lumbricillus santæclaræ*.

*Locality.*—Banks of Santa Clara Creek, San Mateo County, California.

*Characteristics.*—The prominent feature in this species is the shape of the spermatheca and the very thin disc of glands at its base.

#### DETAILED DESCRIPTION.

Three specimens were dissected and three sectioned, one of them transversely. As none of the specimens had been properly fixed, no attempt is made to describe the finer structure.

*Length.*—The specimens at my disposal varied somewhat as regards length, some being not over 8 mm., while others were 12 mm. The somites varied between 45 and 55, the most mature specimens being the largest.

*Setæ* vary to the extent that in some specimens the anterior ventral bundles possess one more seta than in other specimens. Thus I have once counted as high as nine setæ in one or two of the bundles. The setæ are of rather uniform size in each bundle.



*Prostomium* and front of the head are blunt or rounded and much bent downward. The mouth is well down on the ventral side. The body-wall is thin and transparent in glycerin specimens, and the inner organs can be fairly well seen. There is but a slight depression between the somites, and the body is smooth and glossy.

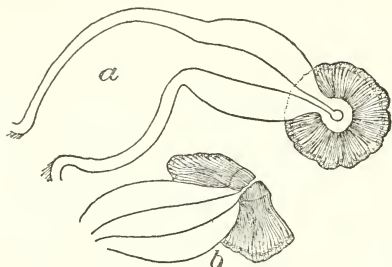


FIG. 45. *Lumbricillus santaclarae*.

*Septal glands*.—There are septal glands in IV, V and VI. The septal part attached to the posterior septum is thick and not lobed, with even outline, and, seen in a longitudinal section of the body, this septal part is as wide and of the same general shape as the interseptal lobe which lies free in the middle of the

somite. There are no salivary glands.

*The brain* (fig. 44) is remarkable for its length. In the most elongated the length is about thirty units, while the width at the center is only twelve units. The posterior margin is deeply emarginated and the two lobes show some slight secondary lobing (fig. 44). There are two lateral muscles, and each central lobe is attached by two muscular strands.

*Spermathecae*.—A contraction at the middle divides the ampulla proper from the more muscular duct. Both parts of about equal size and bent toward each other in a knee-like manner. The glands at the base in the shape of a thin even disc, saucer-shaped, with the concavity toward the intestine. The connection with the intestine wide and reflexed. The form of the spermathecae varies but slightly in the specimens dissected.

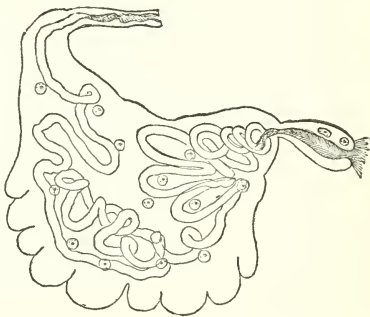


FIG. 46. *Lumbricillus santaclarae*.



*Sperm-ducts* thin and very much coiled, confined to the anterior part of somite XII. The funnels slender and the ciliated mouth turned dorsally. In the upper part of the penial bulb the sperm-duct is thick and muscular, but at the center or below the center the duct becomes thin and loses its muscularity. The glandular cells of the bulb are of two kinds. One kind is confined to a thin lining of the sperm-duct proper (Pl. XIII, fig. 3). The other kind consists of the regular penial glands which open on the surface of the penial papilla.

*Testes*.—The lobes of the testes are oblong pear-shaped, and 8 to 10 in number. In the sectioned specimens the testes were in degeneration and only one or two lobes were seen.

*Intestine* is covered with a thin layer of chloragogen glands.

*Ventral glands* (Pl. XIII, fig. 4).—There are two cellular accumulations on the ventral ganglion, one in XIV and the other in XV. They are both of the same size. Seen in cross-section they are found to be many times wider than the ganglion, but do not rise much above its general level.

*Nephridia*.—There are at least three rows of nuclei. The inner duct is more densely wound at the neck near the anteseptal than in the posterior part of the lobe. The figure (fig. 46) gives a general idea of the windings; the boundaries of the cells could, however, not be made out.

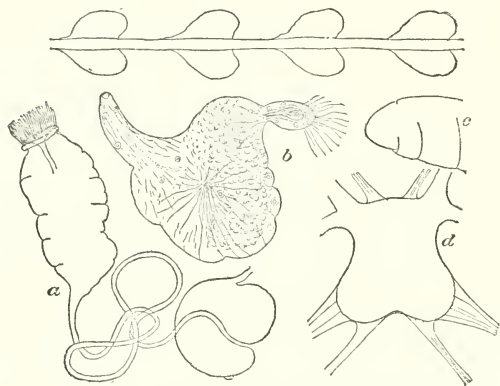
*Lymphocytes*.—None of the specimens contained any lymphatic cells in the anterior part of the body, the only part which was sectioned. Nor could I find any in the dissected specimens.

### LUMBRICILLUS MERRIAM sp. nov.

Pl. XII, fig. 5; text-figs. 47 and 48.

*Definition*.—Length about 12 mm., width .6 mm. Somites 55 to 62. Body transparent, the anterior somites dorsally hardly distinguishable. Prostomium blunt and rounded. Setæ: laterals, 5, 4, 4, 4, 4, 4, 3, 3, 3, 3, 3, 4, 3, 2, 2, 2, 2; ventrals, 4, 5, 5, 5, 5, 5, 5, 6, 6, 4, 0, 4, 3, 3, 3, 3, 3, 3. Head-pore between prostomium and I. Sexual papillæ small, but distinct. Clitellum XI  $\frac{1}{2}$  XIV, not prominent. Septal glands in IV to VII. Brain almost square or a little longer than broad, posteriorly deeply emarginated, anteriorly slightly convex. Spermathecae with large basal gland rosette and with the stalk pyramidally covered with glands. Apical ampulla small and conical, about one-third of the whole spermatheca. Sperm-ducts only about twice as long as the funnel, narrow. Funnel about three times as long as wide, with small recurved collar. Penial bulb comparatively large,

about one-half to one-third shorter than the funnel. Testes large, filling the whole somite, and consisting of from 12 to 15 lobes, each lobe consisting of about three secondary lobes, each of which terminates in a sperm-cap. Ovaries pluri-lobed, smaller than the testes. Ventral glands all of the same size, about six times as wide as the ventral ganglion, situated in XIV to XVII. Nephridia with small anteseptal consisting alone of the nephrostome. The anterior part of the post-



FIGS. 47 AND 48. *Lumbricillus merriami*.

septal is covered by wart-like elevations, under which the duct is much twisted; no warty elevations in the posterior part of the postseptal; stalk short and thick; duct narrow and difficult to follow.

Lymphocytes

variable, ovoid, more or less pointed. Color of formalin specimens decidedly gray. The body is smooth and rather glossy.

*Locality*.—Metlakatla, Alaska, June 4, 1899, Prof. W. E. Ritter. Under decaying seaweeds. A single specimen from Popof Island, collected by Prof. Trevor Kincaid. The species is named for Dr. C. Hart Merriam.

*Characteristics*.—The specimens which apparently had been placed directly in the formalin solution had not contracted sufficiently to show any deep intersegmental grooves. This characteristic made it easy to pick out the species from others collected at the same time and in the same locality. The intersegmental grooves between the first few anterior somites are dorsally so shallow that it is with difficulty that the somites can be distinguished one from the other.

*Setæ*.—In the majority of fascicles the setæ diminish toward one side, but while in some the diminution is toward the ventral interval, in others it is toward the lateral interval, following apparently no constant rule.

*Spermathecæ* (pl. XII, fig. 5).—The apical ampulla small and tapers toward the intestine; the entrance to the intestine not at the apex, but nearer the base of the ampulla.

### LUMBRICILLUS MERRIAMII ELONGATUS var. nov.

pl. XII, fig. 6; test-fig. 49.

*Definition.*—Brain less emarginated posteriorly, slightly longer and narrower than the species. The ampulla of the spermatheca is about equal to the glandular duct. There is about one more seta in the majority of the fascicles than in the species. Testes with about ten lobes. Sperm-funnel shorter and more globular than in the species.

*Locality.*—Metlakatla, June 4, 1899. Found under seaweed together with the species.

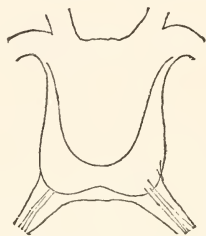


FIG. 49. *Lumbricillus merriamii elongatus*.

### LUMBRICILLUS ANNULATUS sp. nov.

pl. XVIII, fig. 1; text-figs. 50-52.

*Definition.*—Length about 12 mm., width about .75 mm. at clitellum, from which point the body strongly tapers toward each extremity. Somites about 56. Setæ: laterals, 5, 5, 6, 6, 6, 5, 5, 5, 6, 4, 3, 3, 4, 4, 4, 3, etc.; ventrals, 6, 6, 8, 8, 8, 7, 9, 8, 7, 7, 0, 6, 6, 6, 5, 5, 5, etc. Prostomium slightly potted. Except for the first few somites the intersegmental grooves are very deep. Clitellum  $\frac{1}{2}$  XI  $\frac{1}{2}$  XIV. Sexual papillæ not large, but still quite prominent. Septal glands in IV to VII. Brain with a slight emargination posteriorly; the lateral retractor muscles are unusually broad at their attachment to the brain. Dorsal vessel rises in from XVI to XIV. Intestine covered with a thin layer of chloragogen cells; in XII this layer consists of very few and very small cells. Spermathecæ with basal collar of glands and with a thick layer of glandular cells extending to the apex of the ampulla; the latter is hardly differentiated. Sperm-ducts short and narrow. Sperm-funnels about twice as long as broad, and about one-third longer than the penial bulb. The penial bulb contains three different kinds of long, narrow cells. Ovaries in XII much lobed. Testes in XI penetrate the septum into X, partly filling that somite. Ventral glands of large size in XIV to XIX, small ones not projecting beyond the ganglion and only perceptible in sections, in III to X. Nephridia with anteseptal consisting only of the nephrostome; rounded,

thick and rugose postseptal body and short postseptal duct. Lymphocytes variable, irregularly ovoid, with filamentous ends. Color deep gray.

*Locality.*—Metlakatla, Alaska, June 4, 1899 (under seaweed); also Orca, Prince William Sound.

*Characteristics.*—This species and *L. merriami* were contained in the same bottle and must have come from the same locality and lived

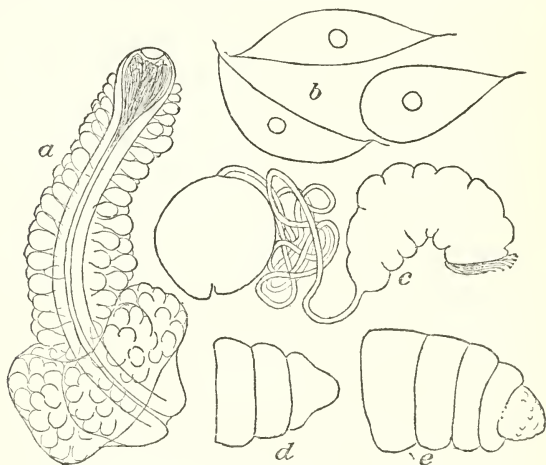


FIG. 50. *Lumbricillus annulatus*.

under the same conditions. From *L. merriami* this species could be readily distinguished by its deep intersegmental grooves, which give the body a decidedly annulated appearance.

#### DETAILED DESCRIPTION.

*Sexual papillæ.*—They are prominently projecting in all the specimens in the collection. The structure of the penial bulb differs little or not at all from that found in other species, except in so far as the bulb seems to be capable of being greatly protruded.

*Septal glands.*—These glands, which are of large size, are clustered around the septa separating somites IV/V, V/VI and VI/VII.

*Brain.*—This organ varies considerably as regards width. Two figures are given of the extremes found by dissection.

*Nephridia*.—These organs are covered thickly with small bladder-like elevations to the extent that the inner ducts cannot be followed. There are no special granulations on the main body near the nephrostome. The inner duct seems to be wide.

*Setæ*.—In the majority of the fascicles, both the ventral and the lateral ones, the setæ next to the lateral interval are the smallest. In each fascicle the majority of the setæ are of about the same length.

*Spermatheca* (fig. 50, *a*).—The whole duct, up to the very connection with the intestine, is covered with glandular cells grouped in papillæ-like bunches, giving to the spermatheca an uneven and warty outline.

The basal glandular collar has, however, a perfectly even outline, and the outline of the various cell-groups do not in the least project exterior to the general margin of the collar. The cells in the collar are somewhat narrower than those in the envelope of the duct. The chamber of the ampulla, which is full of spermatozoa, is entirely confined to the lumen of the duct and does not cause a bulging out as in some other species.

*Ventral glands*.—As has been stated in the definition, large ventral glands are found in XIV to XIX. These posterior glands are of about

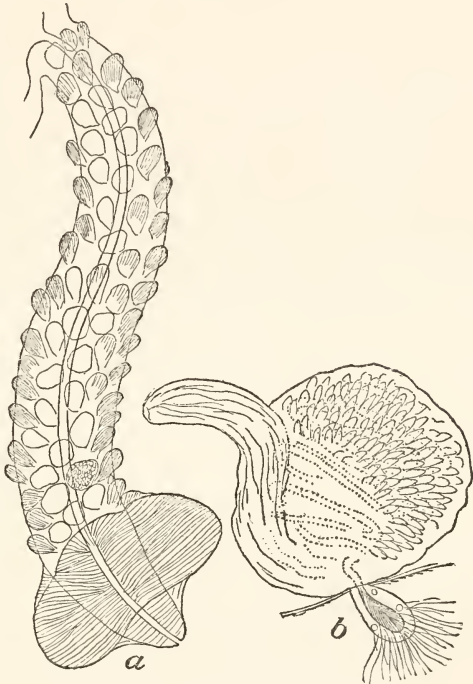


FIG. 51. *Lumbricillus annulatus*.

the same size—about one and a half to two and a half times as wide as the diameter of the ventral nerve cord. They are wing-like and do not bend over the ganglion but stand out laterally. In the anterior somites from XI to II, cross-sections show that the large dark staining cells, which form an integral part of the ganglion, and which do not project outside of the ganglionic lining, send down ducts through the body-wall and through the epidermis in exactly the same manner as do the ventral glands posterior to the clitellum. The only difference seems to be that the anterior cells in question are smaller and fewer in number and confined to a much smaller space. Posterior to the clitellum the area perforated by the ducts is equal to about one-half the length of the somite, while in the anterior somites the area is perhaps

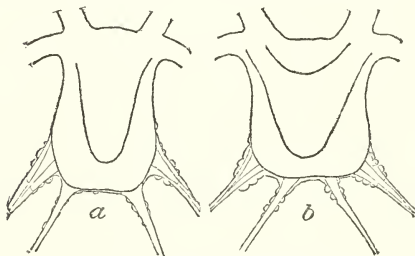


FIG. 52. *Lumbricillus annulatus*.

only one-fifth of the length of the somite. There is probably no great functional difference between the two sets of cells.

*Lumbricillus annulatus* from Orca.—The specimens from Orca differ in a few slight particulars from those from Metlakatla.

The spermathecae are slightly longer and without any trace of an inner chamber for the reception of the spermatozoa. The color is pure milky white. The prostomium is more rugose and somewhat more pointed than in the specimens from Metlakatla. In other respects the specimens from the two localities resemble each other.

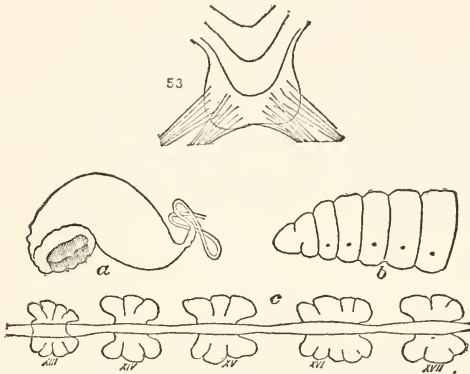
The size and shape of the glands lining the duct of the spermathecae vary almost indefinitely. In some specimens the agglomerations are small and far from each other, in other specimens they are large and crowd one another.

#### LUMBRICILLUS RITTERI sp. nov.

pl. XIII, figs. 5-9; text-figs. 53 and 54.

*Definition*.—Length 25 mm. or less, width 2.5 mm. or less. Somites about 60. Prostomium rounded and short. Somite II narrow. Setae typical: ventral, 9, 8, 9, 9, 8, 8, 8, 8, 7, 7, 0 (XII), 5, 5, 5, 5, 5, 7, 5, 5, etc.; other specimen: ventral, 5, 5, 5, 5, 6, 6, 6, 5, 6, 7, 0 (XII), 5, 5, 5, 4, 4, 5, 5, 6, 5, etc.; lateral, 5, 5, 5, 5, 6, 6, 6,

5, 6, 5, 0 (XII), 5, 5, 5, 4, 4, 5, 4, 4, etc.; second specimen: lateral, 3, 3, 4, 4, 3, 4, 4, 4, 4, 4, 0 (XII), 3, 3, 4, 4, 3, 4, 3, etc. Clitellum well marked.  $\frac{1}{2}$  XI, XII, and XIII. Sexual papillæ small. Septal glands typical. Brain almost square or slightly oblong, posteriorly almost straight with a shallow emargination, the anterior arms thick. Dorsal vessel rises posterior to clitellum. Spermathecæ with a thick apical ampulla and with a narrow duct, which is covered both at its base and all along its sides with accessory glands; the ampulla connects with the intestine. Sperm-ducts narrow, coiled in XI. Sperm-funnels thick and curved. Penial bulb oblong. Testes large, with many lobes capped by comparatively large sperm-sacs. Ovaries multilobed, large.



FIGS. 53 AND 54. *Lumbricillus ritteri*.

Ventral glands in XIII to XVII, the individual glands being comparatively small, about four or five times as wide as the ganglion. Nephridia with short anteseptal, posterior to which is the thick, opaque, granulated neck of the main nephridial body. Color of formalin specimens white, clitellum pink.

*Locality*.—Farragut Bay, Alaska, June 5, 1889, Prof. W. E. Ritter.

*Characteristics*.—The spermathecæ, the brain, and the ventral glands are all characteristic of the species. The spermathecæ possess glands not only at the base, but also along the muscular duct.

*Testes*.—Testes large and completely fill the somites in which they are situated. Consist of some twenty to twenty-five lobes each, each



lobe being narrow, of rather even thickness, and at the apex capped by the usual sperm-sac.

*Ovaries* multi-lobed, large, occupying all the available space in somite XII.

*Ventral glands* (fig. 53, c).—The glands in the respective somites of nearly equal size; the most anterior one the smallest and the fourth in order the largest. The individual glands smaller than in *L. franciscanus* and in *L. santaclaræ*.

*Setæ*.—The number of setæ in the fascicles seems to be variable. Of the two counts given the higher number is the most common.

### LUMBRICILLUS FRANCISCANUS sp. nov.

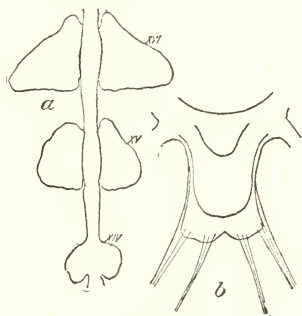
Pl. XIII, figs. 1 and 2; text-figs. 55-57.

*Definition*.—Length 10 to 12 mm., width .75 mm. Somites 39 to 58. Setæ: ventrals, 6, 5, 4, 3; laterals, 4, 3, 3, 2. The lateral interval about double the width of the ventral interval. The setæ in each bundle of nearly equal size. Head-pore large, between prostomium and somite I. Prostomium round, blunt. Clitellum XII and XIII. Copulative papilla small. Septal glands in IV to VI. Brain strongly emarginated posteriorly, about thirty units long by fifteen wide at center. Dorsal vessel rises in XIV or XV. Intestine with a thin layer of chloragogen cells. Spermatheca with an oval ampulla and a thin straight duct, the latter surrounded along its whole length by a conical shaped agglomeration of glands. Sperm-ducts thin and long. Sperm-funnels about twice as long as thick. Ventral glands in somites XIV, XV and XVI, increasing in size posteriorly. Ovaries in XII, testes in XI. The testes lobes are short, rounded, pear-shaped. Nephridia are longer than broad. Lymphocytes oval, varying considerably as regards size.

FIG. 55. *Lumbricillus franciscanus*.

*Locality*.—Santa Clara River, California, in the moist soil of the banks.

*Characteristics*.—The species is distinguished principally by the form of the spermatheca and the glands at the base. In *P. santa-*

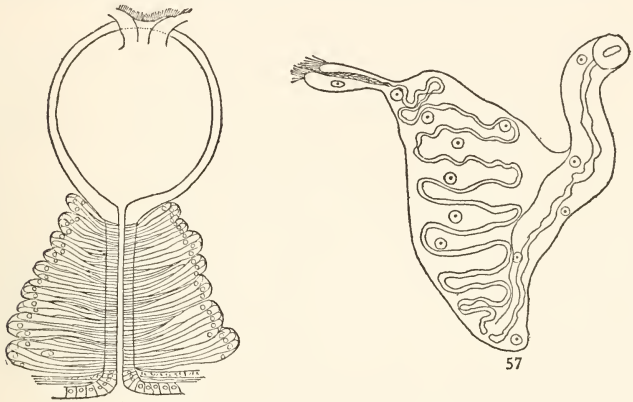




*claræ* these glands are in the form of a thin disk and confined to the very base of the spermatheca, while in this species the glands extend all the way up to the pouch. The species is also characterized by its many ventral glands, these being present in three somites.

#### DETAILED DESCRIPTION.

*Somites*. — There is a great variation in the number of somites, the smallest adult worms possessing only 39, while the largest one had as many as 58. As I did not possess a sufficient number of the smaller size I must leave it to the future to ascertain whether perchance there are other differences between the larger and the smaller specimens.



56 FIGS. 56 AND 57. *Lumbricillus franciscanus*.

*Septal glands*. — These are thick and rounded, and the septal part is about equal to the interseptal part.

*Dorsal vessel* has already risen in XVI. How much further it extends posteriorly I do not know, as I did not section further. In that somite it is large and covered with long chloragogen glands. Similar glands also surround the intestine throughout its length.

*Spermathecæ* (fig. 56). — The ampulla is rounded, oval, or sometimes a little pointed. The opening connecting with the intestine is not at the apex but a little below it. The walls of the ampulla are thin. The duct is straight, cylindrical, and of even thickness. It is covered along its whole length with glands which are much longer at the base of the spermatheca than at the junction with the ampulla. The duct and ampulla are of about the same length.

*Sperm-ducts* are thin, long, and much coiled, and confined to somite XII. The *funnels* are thicker than in *L. santæclaræ*, and also shorter. The penial bulb is globular. The sperm-duct enters on the outer side and remains free inside the bulb for a considerable distance. Only the lower fourth is covered with long and thin glands (Pl. XIII, fig. 1). There are also two sets of penial glands opening close to the sperm-duct, but enclosed in the penial bulb. In *L. santæclaræ* the glands cover the sperm-ducts along three-fourths of their entire length inside the penial bulb.

*Testes* are strongly racemose and the lobes are rounded and pear-shaped. The lobes are more rounded and less pointed than in *L. santæclaræ*. Each lobe is covered with its own sperm-sac.

*Ventral glands*.—This species possesses ventral glands attached to the ventral ganglion in each one of somites XIV to XVI. The glands are larger, increasing posteriorly, and extend far out into the cœlom (Pl. XIII, fig. 2), being four to five times as long as the ganglion is wide. In the posterior one of these somites the glands enclose the ganglion almost completely.

*Lymphocytes*.—These do not exist in all specimens. Thus the specimen sectioned did not contain any lymphocytes, while in a dissected one there were many.

*Nephridia*.—The duct very thick and comparatively short, varies considerably in the respective nephridia. There may be segregated two types, one with thick duct, and one in which the duct is narrower and also a little longer.

### LUMBRICILLUS FRANCISCANUS BOREALIS var. nov.

Text-fig. 58.

*Definition*.—Length 15 mm., width 1.25 mm., all contracted specimens. Somites 62. Setæ sigmoid, the outer one in the ventral fascicles and the inner one in the lateral fascicles much smaller than the other: laterals, 4, 5, 5, 5, XIII, 3, 4, 4, 4, 3; ventrals, 6, 7, 7, 7, XIII, 4, 4, 4, 4, 3. Head-pore between prostomium and somite I. Clitellum XII and XIII. Copulative papilla small. Salivary glands large, IV to VI. Brain almost square, broader anteriorly; anteriorly slightly emarginated, posteriorly considerably emarginated. Spermatheca with a duct and an ovoid ampulla, the former surrounded along its whole length with glands, broadening toward the base. Sperm-ducts narrow, confined to somite XII. Sperm-funnels broad and slightly curved. Penial papilla more oblong than in the species. The lobes of the testes are oblong, pear-shaped, with rounded sperm-sacs. Ven-

tral glands in XIII, XIV and XV, those in the last two much larger than the one in XIII. The glands are larger than in the species. Nephridia with a thick duct. The middle lobe with slightly lobed margin. Color pale yellowish white (alcoholic specimens).

*Locality*.—Two mature and three immature specimens from St. Paul Island, Pribilof group, Alaska, Prof. Trevor Kincaid (August).

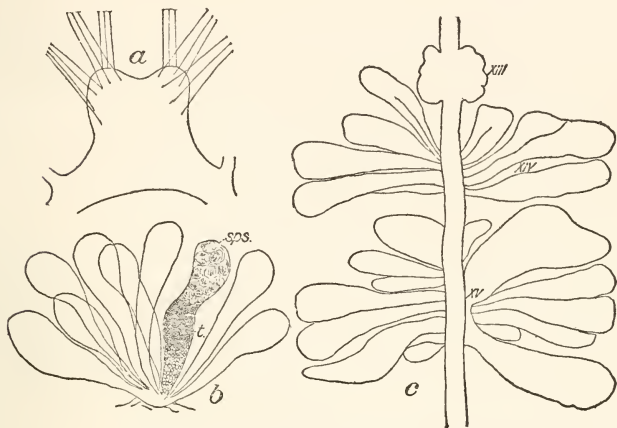


FIG. 58. *Lumbricillus franciscanus borealis*.

*Characteristics*.—The principal differences between this variety and the species are as follows: The ventral glands are considerably larger in the variety. The setæ in the species are of about equal size in the same fascicle. In the variety *L. borealis* the inner setæ in the lateral fascicles and the outer seta in the ventral fascicles are markedly smaller than the other setæ in the same fascicle. The width of the variety is about twice that of the species. The ventral anterior fascicles contain one more seta in the variety.

#### LUMBRICILLUS FRANCISCANUS UNALASKÆ var. nov.

Text-fig. 59.

*Definition*.—Length 17 mm., width 1.2 mm. Somites 72. Setæ sigmoid, all of the same size in fascicle: ventrals, 4, 6, 6, 6, 6, 6, 6, 6, 6, 0 (XIII), 3, 5, 5, 4, 4, 3; laterals, 5, 4, 5, 5, 5, 5, 4, 3, 3, 3, 3 (XIII), 2, 3, 3, 3, 3. Brain square, posteriorly truncate, ante-

riorly slightly emarginate. Color bright ochraceous yellow (alcoholic specimens). Ventral glands very large (but not as large as in *L. franciscanus* var. *borealis*), in XIII and XIV. Lymphocytes large, oval, pointed, numerous. In other respects similar to the species.

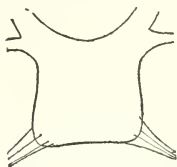


FIG. 59. *Lumbricillus franciscanus unalaskæ*.

*Distribution*. — Unalaska, Prof. Trevor Kincaid (September).

*Characteristics*. — The squareness of the brain and the fact that all the setæ are of the same size in each fascicle distinguishes this variety from *L. f. borealis*. From the species it differs principally in size and in the form of the brain. As regards the number of setæ, this variety stands between the species and *L. f. borealis*.

### Genus *Marionina* Michaelsen.

*Definition*. — Setæ sigmoid, as in *Lumbricillus*. Head-pore small, between prostomium and somite I. No dorsal pores. Blood red or yellow. Dorsal vessel rises posterior to clitellum. No cardiac gland. No peptonephridia. Sperm-ducts comparatively long and narrow. Penial bulb without interior muscular strands. Testes undivided, each covered by a small sperm-sac. Ventral glands present or absent. Nephridia with entire postseptal and with comparatively large head-like anteseptal.

To the original definition of this genus I have added the characters concerning the testes and their sperm-caps and the structure of the penial bulb. The principal difference between *Marionina* and *Lumbricillus* concerns the testes, as is now well known. But I think that another difference may be derived from the nephridia, which in *Marionina* seem to be characterized by a large head-like anteseptal, while in *Lumbricillus* the anteseptal consists of merely the nephrostome.

#### DETAILED DESCRIPTION.

*Penial bulb*. — The penial bulb resembles that of *Lumbricillus* in general structure. There are two sets of glandular cells opening in the bulb. One set opens into the lower part of the sperm-duct, while the other opens onto the base around the pore.

*Nephridia*. — These organs have not been described in all species and general conclusions cannot therefore be made for the present. There seem, however, to be two types, one with a short anteseptal consisting of a mere nephrostome, while the other type possesses a

large anteseptal, almost equalling in size the postseptal lobe. So far as I know, the latter type of nephridia has not been described in *Lumbricillus*.

#### SYNOPSIS OF SPECIES OF MARIONINA DESCRIBED IN THIS PAPER.

##### I. SPERMATHECA WITHOUT DIVERTICLES.

Spermatheca with long duct and with an ampulla which is contracted at several points. Interior of spermathecal duct ciliated. Ventral glands in X and XI. Nephridia with large anteseptal..... 1. *M. alaskæ* sp. nov.

##### II. SPERMATHECA WITH TWO DIVERTICLES.

Spermatheca with a long duct at the base of which are a few small glands. Head-pore immediately in front of the groove between prostomium and somite I. No ventral glands..... 2: *M. americana* sp. nov.

#### MARIONINA ALASKÆ sp. nov.

pl. xiv, figs. 2-6; text-fig. 60.

*Definition*.—Length 12 mm., width .85 mm. Somites 53. Prostomium blunt and rounded. Setæ sigmoid: ventrals, 4, 6, 6, 7, 5, 6, 6, 5, 6, 4, 0, 5, 4, 5, 4, 3, 4, 5, etc.; laterals, 3, 4, 5, 6, 5, 5, 5, 5, 5, 4, 0, 4, 4, 3, 3, 3, 3, 4, 3, etc. Head-pore small between prostomium and somite I. Dorsal pores (?) in II, III and IV. Clitellum dorsally XII and XIII, ventrally XII,  $\frac{1}{2}$  XIII. Sexual papillæ distinct. Septal glands in IV to VI. Dorsal vessel rises in XII. Intestine gradually increasing in size; no diverticles. Spermathecæ large, with narrow, strongly muscular duct and a wider ampulla, which is continued as a narrow thin-walled duct until its junction with the intestine in VI/VII. Sperm-ducts narrow and long. Sperm-funnels about three times as long as wide. Penial bulb with two kinds of glandular cells opening into the sperm-duct and around the pore. No ovisacs. Ventral glands in X (and perhaps in XI). Nephridia with large anteseptal in which the duct is coiled. Lymphocytes large, circular and disc-shaped. Color of alcoholic specimen yellow. No pigment.

*Locality*.—Port Clarence, Alaska, Dr. Anton Stuxberg, Vega Expedition (July 26, 1878). A single specimen.

*Characteristics*.—The form of the spermatheca, with its narrow duct connecting with the intestine, and with its three basal glands, seems fully to characterize this species.

#### DETAILED DESCRIPTION.

On account of the want of specimens for dissection, the form of the brain remains unknown.

*Body-wall*.—The circular muscular layer consists of cells arranged on the nematode plan as described by Hesse (1). The plates are set at a rather wide angle (pl. xiv, fig. 2).

*Spermathecae* (pl. xiv, figs. 3 and 4).—The long muscular duct is covered exteriorly by parallel muscular strands. Viewed in cross-section it is seen that the strands are separated one from the other. The narrow duct of the ampulla is continued parallel to the intestine as far as the septum VII/VIII, where it enters the intestine. There are three large basal glands which enter the somewhat enlarged duct.

*Sperm-funnel and duct*.—The funnel is about twelve times as wide as the duct. The latter is confined to somite XII.

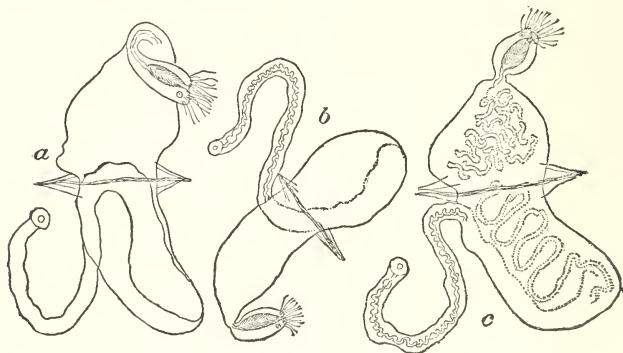


FIG. 60. *Marionina alaskæ*.

*Nephridia* (fig. 60).—The anteseptal is very broad and almost as long as the main body of the postseptal. The duct is either strongly coiled in the anteseptal or forms a network of anastomosing ductules. The nephridia are somewhat variable in shape. The figures are all from nephridia posterior to clitellum.

*Dorsal pores*.—There is considerable doubt as to the presence of the dorsal pores. Close in front of the septa of the four anterior somites there is a structure closely resembling the cells which generally surround dorsal pores, but I have been unable to see the respective openings. Hence the question mark in the definition.

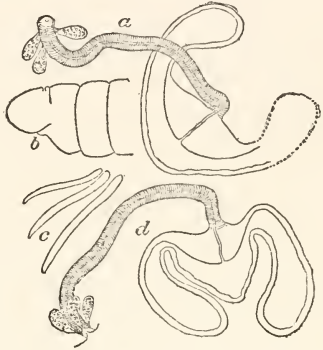
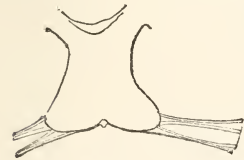
*Papillæ*.—There are two exterior papillæ anterior to the male pores, one ventral and situated somewhat to one side of the median line in XI, the other in somite VI also slightly on one side of the median ventral line. My longitudinal sections did not show their structure.

*Setæ*.—The setæ are slightly sigmoid. The ventral setæ diminish in size toward the ventral interval, while the lateral setæ diminish in size toward the dorsal interval.

## MARIONINA AMERICANA sp. nov.

Pl. XIV, fig. 1; text-figs. 61 and 62.

*Definition.*—Length 10 mm., width .5 mm. Somites about 50. Prostomium blunt. Setæ: ventrals, 2, 2, 2, 2, 2, 3, 3, 2, 2, 2, 0, 2, 4, 4, 4, etc.; laterals, 2, 2, 2, 2, 3, 2, etc. Head-pore immediately in front of the groove between prostomium and somite I. Clitellum small, XII and XIII. Sexual papillæ small, cylindrical, truncate. Brain posteriorly slightly emarginate; posteriorly much broader than anteriorly. Dorsal vessel rises posterior to clitellum. Intestine with few and thin chlo-ragogen cells. Spermathecae consist of a narrow and comparatively long duct, and a short and wide ampulla furnished with two short diverticles; the ampulla does not seem to connect with the intestine. The penial bulb contains two kinds of glandular cells, one kind being more granular and staining more deeply than the other. Sper-

FIG. 61. *Marionina americana*.FIG. 62. *Marionina americana*.

duct narrow and coiled, confined to XII and XI. Testes entire, but covered by a cap-like sperm-sac confined within XI. No ovisac. No ventral glands. Lymphocytes large, rounded, disk-like. Color pale, without pigment.

*Locality.*—Port Clarence, Alaska, Dr. Anton Stuxberg, Vega Expedition (July 23 to 27, 1879). A single specimen.

*Characteristics.*—The single specimen being in a poor state of preservation prevented any detailed investigation. The anterior part of the worm was sectioned transversely. The nephridia are not in a sufficient state of preservation to allow their finer structure to be satisfactorily studied. The spermatheca is distinctly characteristic of the species.

*Setæ.*—The setæ of the ventral fascicles diminish in size toward the ventral interval, while those of the lateral fascicles diminish toward



the dorsal interval. The setæ are slightly sigmoid. An immature specimen, found in the same vial and possibly belonging to the same species, possessed an average of one more seta in each fascicle.

### Genus *Bryodrilus* Ude.

*Definition.*—Setæ sigmoid. Head-pore between prostomium and somite I. No dorsal pores. Esophagus gradually emerging into the intestine. Blood colorless. Dorsal vessel rises in the clitellum; with or without cardiac gland. Peptonephridia rudimental. Testes solid. No sexual ventral glands. Spermathecæ connected with the intestine. Penial bulb without interior muscular strands. Intestine with four diverticles in somite VIII. Nephridia with branched inner duct.

*Penial bulb.*—The penial bulb in the present species of *Bryodrilus* is built on the same principle as in *Fridericia* and *Lumbricillus* though it is somewhat more complicated, as will be described more in detail under the species. Here it is sufficient to point out that there are two sets of glands, one opening into the sperm-duct, the other in small depressions on the base of the bulb.

*Nephridia.*—They are of the *Enchytræus* type but the ducts are more complicated, being much branched (at least in one species). The anteseptal consists of a mere nephrostome.

#### SYNOPSIS OF SPECIES OF BRYODRILUS.

Setæ distinctly sigmoid, 3-5 in each fascicle. Brain posteriorly convex.

1. *B. ehlersi* Ude.

Setæ indistinctly sigmoid, 2 in each fascicle. Brain posteriorly emarginate.

2. *B. udei* sp. nov.

### BRYODRILUS UDEI sp. nov.

Pl. XII, figs. 1-4; text-fig. 63.

*Definition.*—Length 25 mm., width 1.25 mm., somites 56, or length 25 mm., width .75 mm., somites 75. Setæ almost straight and short; in couples; eight in each somite. Head-pore between somite I and prostomium. Clitellum dorsally and ventrally XI, XII and XIII. Copulatory papilla distinct, and rounded or truncate, with a longitudinal slit at apex. Ovipores elevated. Septa not thickened. Septal glands in IV to VI. Salivary glands (?) rudimentary. Brain slightly longer than wide, emarginated both anteriorly and posteriorly. Dorsal vessel originates in XII and is furnished with a cardiac gland. Intestine with a thin layer of chloragogen cells. Four intestinal diverticles in VIII connecting with the intestine at the posterior septum. Spermathecæ without diverticles, grown together at apex and opening through a common duct into the intestine. Sperm-ducts very narrow,



confined to somite XII. Funnel large, longer than wide, in XI. No sperm-sacs and no ovisacs. No prostates, but small and numerous penial glands confined by the peritoneum and the penial bulb. No ventral glands. Ovaries in XII and testes in XI. Nephridia with a short anteseptal, a rectangular central lobe, and a long duct. Lymphocytes round, flat, about one-third the width of the short diameter of the nephridium.

*Locality.*—Port Clarence, Alaska, July 23–26, 1878. Dr. Anton Stuxberg, Vega Expedition.

*Characteristics.*—This species is readily distinguished from the type species, *B. ehlersi*, by its large intestinal diverticles, its brain, which is emarginated both posteriorly and anteriorly, and by its setæ, which are so short that they cannot be studied on undissected specimens. Their number is also characteristic, there being only two in each bundle.

#### DETAILED DESCRIPTION.

*Size.*—It is remarkable that the relative length and width should vary to such extent that with the same length some specimens are but half as wide as others. I suspected at first that I had before me two distinct species, but I am unable to distinguish any characteristics that would accompany the difference in size. There are in all eight specimens in the collection, two of which are thick, the others thin. One of the thick specimens was sectioned longitudinally, while of the thin ones one was sectioned transversely and one was dissected.

*Somites.*—The body is of an even thickness and the somites though distinct are hardly set off from each other, the intersegmental grooves being exceedingly shallow. This gives the body a smooth, even, and glossy appearance. It is to be remarked that the thin specimens possess the largest number of somites.

*Setæ.*—The setæ are not distinctly sigmoid but almost straight. They are also very short (pl. XII, fig. 3a). They begin with somite II, and are arranged in couples, there being thus eight in each somite, except in the last, where there are only four.

*Copulative organs.*—The exterior papilla short, broad and truncate, with a longitudinal slit at the apex into which open the sperm-duct

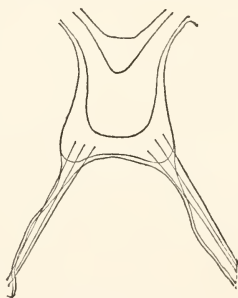


FIG. 63. *Bryodrilus udei*.

and the penial glands. Behind the papilla lies the penial bulb, enclosed and confined by the peritoneum. It is thus sharply defined toward the cœlom, into which it slightly projects. The center of the bulb is occupied by the penial part of the sperm-duct, while on each side of the latter there are two groups of penial glands opening respectively by two pores, one in front of and one posterior to the spermiducal pore proper. The glands which open in the lower part of the sperm-duct inside the bulb are covered by thin strands of muscles, thus giving the appearance of a bulb within a bulb. This arrangement resembles that in *Mesenchytræus*, but is not found in any other species of the subfamily of Lumbricillinæ. But the arrangement of the glands which open in the lower part of the sperm-duct is in other respects similar to that found in the genera *Henlea* and *Fridericia*, as well as in *Marionina*. In *Mesenchytræus* only few species possess similar glands which open in the lower part of the sperm-duct, while in Lumbricillinæ such glands are found in all the species examined by me. No atrium and no atrial glands. The sperm-duct very narrow and repeatedly convoluted, but owing to the fact that it is confined to somite XII, it cannot be more than three or four times as long as the sperm-funnel. The latter is longer than broad and points forward, being confined to somite XI. This latter is full of spermatozoa and the septum X/XI is pushed far forward against the intestinal glands in VII.

*Testes* solid and quite large.

*Spermathecæ*.—These organs appear to resemble those of *B. ehlersi* described by Ude. The duct is long, narrow and even as to thickness. It opens into a thin-walled sac which lies principally in VI. The two sacs are grown together and continued as a narrow duct, which at first runs parallel to the intestine and then penetrates it somewhere in somite VII, probably in the posterior part of the somite close to the septum VII/VIII. The spermathecæ open exteriorly, as usual, at the opposite ends of the transverse diameter of the body. They are not accompanied by any glands.

*Septal glands*.—These offer no particular characteristics. They are of large size and are partly attached to the septa and partly lie free in the cœlom. They open into the intestine just behind and on each side of the pharynx (pl. XII, fig. 1, *glu*).

*Salivary glands*.—In this species I find structures corresponding to those described by Ude in *B. ehlersi* as strongly rudimentary salivary glands. It seems to me more probable that these small compact bodies are of a ganglionic nature and not glandular. There is no duct

and no indication of any secretion. Moreover, a part of their mass lies wholly in the septal gland and resembles greatly the structure which Michaelsen (3) has described as ganglionic in the septal glands of *Mesenchytraeus setosus*. In *B. udei* these ganglia are oblong or pear-shaped and lie close together on the dorsal median line just behind the pharynx. Posteriorly they extend into the septal glands, while anteriorly they continue forward into two fibrillar bands, which I take to stand in connection with the main nervous system. These structures do not resemble the peptonephridia of the other genera.

*Brain* very different from that of *B. ehlersi*. The posterior margin is emarginated and the brain is slightly longer than broad.

*Dorsal vessel*, just as in *B. ehlersi*, rises in somite XII from a fold in the intestine, and does not in any way connect with the intestinal diverticles. There is a heavy blood sinus in the gut in somite V.

*Intestine*.—The most interesting part of the intestine is the four diverticles situated in VII. In Ude's original paper ('93) the diverticles of the species are described by him as being situated in VII, but in a later ('95) and more elaborate paper this is corrected to VI. In my specimens of *B. udei* it is not easy to decide upon the somite containing the diverticles, as the tender septa are somewhat ruffled on account of sand in the intestine, but I am certain that they cannot be referred to VI. They are either in VII or in VIII, more probably in VIII. The diverticles are larger than in Ude's species and differ also from it in originating in the posterior part of the somite near the posterior septum. They project forward, being parallel with the intestine and are grown together with the gut in VI, but do not open into it. The diverticles are wider than the intestine between them and of the same structure. They are arranged latero-dorsally and latero-ventrally. Their inner epithelium is in places much thicker, and is everywhere ciliated.

*Lymphocytes*.—These are large, flat, circular or slightly oval, and about one-third as wide as the nephridia.

*Nephridia*.—There are two forms, one with a kind of posterior fold almost separated from the rest, and one with only one rectangular fold. The duct is long, while the anteseptal is very short, consisting merely of the nephrostome. Postseptal duct projects from posterior end.

*Habits*.—The label contains no notes as regards the habits of this worm, but the intestine contained fragments of moss and much sand, and there is every reason to suppose that the habits are terrestrial.

Genus *Henlea* Michaelsen.

*Definition.*—Setæ variable (like *Fridericia* or *Lumbricillus*). Head-pore small, situated between prostomium and somite I. No dorsal pores. Esophagus narrow and suddenly merges into the intestine. Intestinal diverticles generally present. Dorsal vessel rises anterior to the clitellum. Blood colorless. Lymphocytes large, disc shaped. Brain posteriorly emarginated. Nephridia generally with large anteseptal. Spermathecæ generally without diverticles. Spermducts comparatively narrow and long. Penial bulb without interior muscular strands (*Lumbricillus* bulb). Chylus cells in the intestine in the vicinity of clitellum.

*Affinities.*—The genus *Henlea* as now established is undoubtedly nearest related to *Bryodrilus*. Both genera agree in the most remarkable variation in the various organs. The only real distinction between the two genera lies in the origin of the dorsal vessel. In both genera we find a variation in the form and comparative length of the setæ. These may be either sigmoid (*Lumbricillus*-shaped), straight (*Enchytraeus*-shaped), or straight and of uneven size (*Fridericia*-shaped). The nephridia of the new species are characterized by large anteseptal, probably characteristic of the genus. Salivary glands may be absent, rudimentary, or much enlarged. Even the structure of the penial bulb seems similar in the two genera. The structure is characterized by its two sets of glands, some of which open into the spermducts, while others open into small pore-like depressions on the surface around the base of the penial pore. The presence of intestinal pouches seems to be the rule, there being only a single exception. I have followed Michaelsen in referring *H. dicksoni* to this genus, but I am doubtful as to its correctness. The absence of intestinal pouches, and a small anteseptal distinguishes that species from all others in this genus. These two characteristics are of so great importance that we may well doubt the systematic place of that species.

## SYNOPSIS OF THE SPECIES OF HENLEA.

## I. TWO PAIRS OF SPERMATHECÆ, IN IV AND V.

Spermatheca without distinctly differentiated ampulla and without diverticles.

Setæ in ventral fascicles 8 to 10, in lateral fascicles 5 to 7, arranged in a fan-shaped manner ..... 1. *H. puteana* Vejd.

## II. ONE PAIR OF SPERMATHECÆ ONLY, IN V.

## I. Spermathecæ without diverticles.

Spermatheca slender, with the ampulla hardly wider than the duct. The inner setæ in each fascicle smaller. Brain posteriorly concave. Two large intestinal pouches in VIII. Anteseptal comparatively small. Large peptonenephridia ..... 2. *H. californica* sp. nov.

- Spermathecae with distinctly differentiated ampulla. Large peptonephridia. The setæ of nearly equal length or slightly *Fridericia*-shaped. Anteseptal narrow and comparatively small. Brain posteriorly emarginated. Two large intestinal pouches in VIII/IX ..... 3. *H. leptodera* Vejd.
- Spermatheca with distinctly differentiated ampulla and with a duct nearly three times as long as the pouch. Peptonephridia present. Setæ 6 to 8, the inner ones shorter. Anteseptal narrow and small, brain posteriorly emarginated. No intestinal pouches ..... 4. *H. dicksoni* Eisen.
- Spermatheca with distinct ampulla tapering toward the intestine. No peptonephridia. Setæ variable, generally straight, of equal size, or the inner ones shorter. Anteseptal rather long and narrow, cylindrical. Brain posteriorly deeply notched. Four large intestinal pouches in VIII/IX.  
5. *H. ventriculosa* d'Udek.
- Spermatheca with a distinct ampulla gradually tapering toward the intestine. Peptonephridia large. Setæ about six in a fascicle, the inner ones shorter. Anteseptal broad and large. Brain posteriorly emarginated. Two intestinal pouches in VII/VIII ..... 6. *H. guatemalæ* sp. nov.
- Spermatheca with pear-shaped ampulla, and twice as long as duct. Peptonephridia present. Setæ 4-7, rarely 2-3, straight, of equal length or the inner shorter. Postseptal long and with long duct projecting from its anterior end. Brain posteriorly emarginated. Two intestinal pouches in VII/VIII ..... 7. *H. nasuta* Eisen.
- Spermatheca with central ampulla three times wider than duct. Peptonephridia short, undivided. Setæ straight, of equal length, ventrally 7-8, dorsally 5. Postseptal broad, flat, posteriorly emerging into the duct. Brain posteriorly truncate. No intestinal pouches ..... 8. *H. rosai* Bretsch.
- II. Spermathecae with two distinct diverticles.  
Setæ 4 in the fascicle, the inner ones much shorter. Large peptonephridia. Anteseptal very large and broad. Brain posteriorly convex. Intestine with two large pouches in VIII/IX, extending into VII.  
9. *H. ehrhorni* sp. nov.

## HENLEA CALIFORNICA sp. nov.

Pl. xv, fig. 1; text-fig. 64.

*Definition.*—Length 8 mm., width .75 mm. Somites about 60. Setæ of unequal length in the fascicle, from 4 to 6. No dorsal pores. Prostomium narrow and pointed. Clitellum prominent, XII and XIII. Sexual papillæ small but distinct. Supra-pharyngeal glands small. Septal glands prominent, in V, VI and VII. Peptonephridia begin in IV, closely adhering to the tubular intestine. Brain wider than long, posteriorly as well as anteriorly concave. Dorsal vessel rises in VIII. No chloragogen glands on either blood vessels or intestine. Tubular intestine nipped by the septa; sacculated intestine begins in VIII. Two large intestinal pouches in VIII. Spermathecae tubular, slightly bent, opening into the intestine, at the base furnished with about two accessory glands, no diverticles. Sperm-ducts narrow. Penial bulb with two kinds of glands, one opening into the sperm-duct, the other opening next to the sperm-duct, but all confined to the bulb. Nephridia with small, narrow anteseptal and without glandular

collar. Lymphocytes large, disc-like, in cross-section shuttle-shaped. Color yellowish white.

*Locality*.—Santa Rosa, Sonoma County, California. Under oak trees near the city. May, 1893. All the specimens are adult.

#### DETAILED DESCRIPTION.

*Characteristics*.—This species seems to be well distinguished from nearly all other species by its broad brain and its unequal setæ. The spermathecæ, though tubular without any perceptibly enlarged terminal ampulla, are apparently fully developed. The species differs from *Henlea nasuta* Eisen by its more tubular spermathecæ.

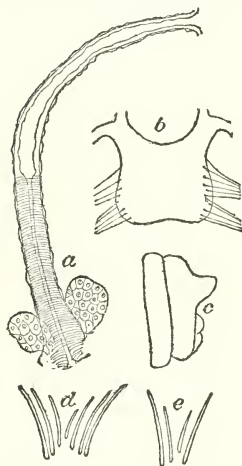


FIG. 64. *Henlea californica*.

*Peptonephridia*.—Judging from a series of longitudinal sections, these glands resemble the figure given by Vejdovsky of *H. leptodera* ('79, Taf. X, fig. 2). The basal part, however, is much larger and more irregularly folded, and the terminal tubules are fewer in number. The glands run close to the intestine and interior to the blood sinus in VII.

The intestinal pouches in VII are similar to those figured by Michaelsen from *H. nasuta* ('88, fig. 1). The villi are fully as intricately folded.

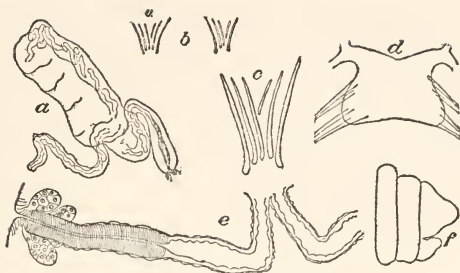
Spermathecæ are more cylindrical than those of *H. nasuta* Eisen ('79), to which species our present form seems closely related. Even as regards the setæ of the two species, *H. nasuta* and *H. californica* resemble each other greatly.

#### HENLEA CALIFORNICA MONTICOLA var. nov.

Text-fig. 65.

*Definition*.—Length 6 mm., width .65 mm. Somites 54. Brain about one-third wider than long. Setæ in fascicles of four, five and six. The setæ bordering the lateral interval are slightly longer. The spermathecæ, which are sharply bent, are furnished with four or more basal accessory glands. Color of formalin specimens white. In other respects similar to the species.

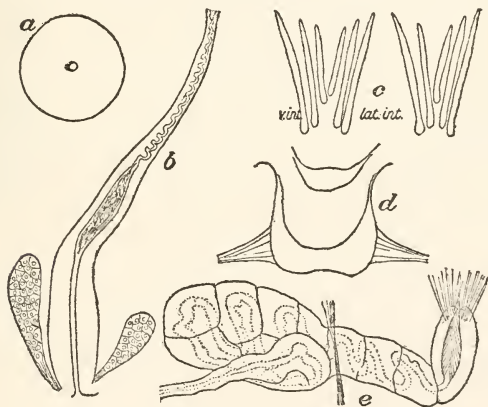
*Locality*.—West Fork of Feather River near Morgan Spring, Dr. Richard C. McGregor (Sept., 1898). The locality is in the Sierra Nevada at an altitude of several thousand feet.

FIG. 65. *Henlea californica monticola*.

## HENLEA CALIFORNICA HELENÆ var. nov.

Text-fig. 66.

*Definition*.—Setæ straight, in fascicles of four, five and six; the most ventral seta in the ventral fascicles and the one facing the lateral interval in the lateral fascicles are slightly larger than the others. Brain almost square with the posterior margin concave. Spermathecæ long and narrow with a central chamber for the spermatozoa and a long

FIG. 66. *Henlea californica helenæ*.

narrow duct communicating with the intestine; the inner lumen in this duct is narrow and tortuous. At the base of the spermathecæ are two long accessory glands. In other respects resembling the species.



*Locality.*—In the moist ground at a spring near St. Helena, Napa County, California, Dr. Richard C. McGregor. A single specimen.

*Characteristics.*—The most important characteristic concerns the long narrow duct of the spermathecæ and their inner tortuous duct. The nephridium is also characteristic, with its large anteseptal and very large nephrostome. As there was only a single specimen no attempt was made to section, and the above description is based on dissection only. The form appears so different that it will probably be found to be a distinct species.

### HENLEA GUATEMALÆ sp. nov.

pl. xv, fig. 7; text-figs. 67 and 68.

*Definition.*—Length 6 to 10 mm., width .75 mm. Somites 67, deeply set and everywhere distinct, prostomium pointed. Setæ straight and arranged fan-like; the most ventral seta of the ventral fascicles

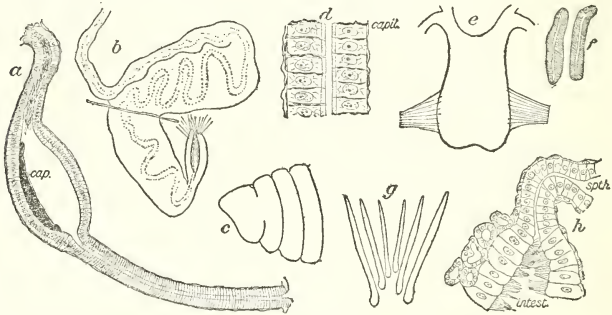


FIG. 67. *Henlea guatemalæ*.

and the most dorsal setæ of the lateral fascicles are generally a little larger; otherwise the central setæ in each fascicle are the smallest. Clitellum thin and contracted. Sexual papillæ small and truncate-cylindrical. Septal glands in IV, V and VI. Peptonephridia large, with a thick and free basal part in III, and a thinner repeatedly folded part in IV to VII, the latter closely adhering to the intestine. Brain almost twice as long as wide, posteriorly emarginate. Dorsal vessel rises in VII in front of the diverticles of the intestine. Intestinal pouches in VII; epithelium with comparatively few folds. Spermathecæ consist of a slender duct about twice as long as the oval



ampulla, the distal end of which is narrow, tubular, and curved, opening into the intestine. Sperm-ducts are narrow, confined to one or two somites. Penial bulb with two sets of glands, all confined to the bulb. No chylus cells. Nephridia with large anteseptal in which the ducts are meandering. Color white.

*Locality*.—In garden soil in the City of Guatemala, Central America.

The occurrence of this genus in a tropical locality like Guatemala, even at an altitude of about 5000 feet would indicate that the species is introduced. So far as we know, all Enchytræids are of arctic or sub-arctic origin, none having been found endemic to the tropics.

#### DETAILED DESCRIPTION.

*Spermatheca* (figs. 67, *a* and *h*).—An interesting feature is the large blood-vessel which is situated inside the spermatheca, lining the inner cavity. It is found only on one side of the cavity (fig. 67, *a*). Even the stalk of the spermatheca is filled with capillaries between the cells. The connection between the spermatheca and the intestine is narrow and twisted (fig. 67, *h*). It is possible that the length of the distal end is somewhat variable.

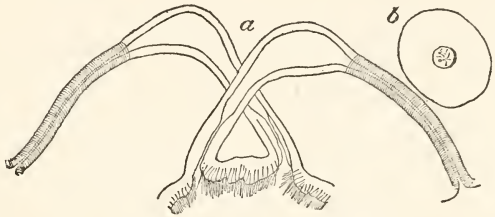


FIG. 68. *Henlea guatemalæ*.

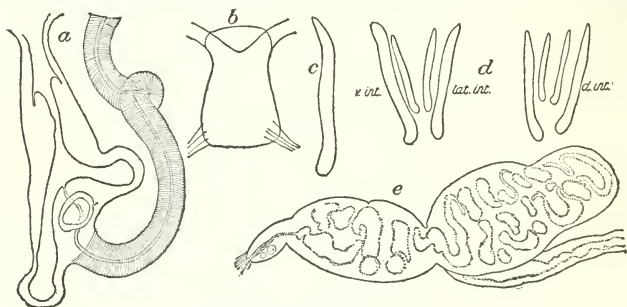
*Penial bulb*.—In the penial bulb the coarsely granulated cells are situated exteriorly, opening on the surface around the pore. The narrower and more finely granulated cells open in the extension of the sperm-duct.

*Somites*.—The majority of the specimens measured 6 to 8 mm. These specimens possessed deep intersegmental grooves even posterior to the clitellum. Two specimens were longer, or about 10 mm. These were posteriorly smooth and showed no distinct intersegmental grooves posterior to the clitellum, except near the tail end. In these latter specimens the spermathecae were slightly different in form but not sufficiently so to warrant the making of a distinct variety. The figure representing two spermathecae crossing each other *in situ* is from these larger specimens (fig. 68, *a*).

## HENLEA EHRHORNII sp. nov.

pl. xv, figs. 2-6; text-fig. 69.

*Definition.*—Length 12 mm., width .5 mm. Somites about 67. The anterior few somites deeply pluri-ringed; the posterior ones, commencing with about VII, are smooth and indistinct. Setæ generally four in each fascicle, the inner setæ much smaller. The most ventral seta in the ventral fascicles and the most dorsal seta in the lateral fascicles are larger than the others. No dorsal pores. Head-pore large, between prostomium and somite I. Prostomium short, blunt, and rounded. Clitellum XII and XIII. Sexual papillæ small and square. Septal glands in IV to VI. Peptonephridia extending into VI. Brain oblong, posteriorly truncated, anteriorly convex. Dorsal vessel rises in VIII. Intestine tubular until VIII, in which somite it is fur-

FIG. 69. *Henlea ehrhorni*.

nished with two lateral diverticles. Sacculated intestine commences in IX. Spermathecae with pyramidal ampulla and furnished with three knob-like diverticles. Penial glands of four kinds, confined to the bulb. Nephridia large, with large anteseptal; inner ducts of varying thickness. Lymphocytes large, as wide as the body-wall is thick, rounded-oval. Color yellowish-white.

*Locality.*—Mountain View, San Mateo County, California. Collected by Prof. Edward M. Ehrhorn, the well-known entomologist, for whom the species is named.

## DETAILED DESCRIPTION.

*Setæ.*—The setæ are more curved in the anterior somites than in the posterior ones. The most ventral setæ are very much larger and especially thicker than the other setæ in the ventral fascicles. In *H.*

*californica* the setæ are of a more uniform size. The figures of the setæ of the two species are not drawn to the same scale, as their respective size is not particularly characteristic. The most ventral setæ in the ventral fascicles are more blunt than the other setæ.

*Peptonephridia*.—The specimen which was sectioned showed the typical arrangement of the peptonephridia, that is, the glands were closely adhering to the intestine. In somite III the glands show several short lobes projecting free out into the cœlom. In somite IV the gland is thin and shows no free lobes. But in V short lobes begin to appear, and in VI they are more numerous, their free projections being about as long as the intestine is wide. In the specimen that was dissected the two salivary glands (pl. xv, figs. 2, 3) were folded on themselves, projecting forward and not in any way adhering to the intestine. Their shape, however, so far as can be judged from a comparison with the sectioned glands, resembles the latter in all particulars except location.

*Intestine*.—The tubular part is furnished in VIII with a pair of diverticles which not only fill the largest part of VIII but also project into VII. The inner lobes of the diverticles are much coarser than in *H. californica*, the villi being less numerous and more of the nature of those of the diverticles of *Benhamia*. At the posterior end of the diverticles there is a large valve opening into the sacculated intestine. The epithelium of the tubular intestine is twice as thick as that of the sacculated intestine.

The *sperm-funnels* are short and ovoid. The sperm-ducts are narrow and apparently confined to the clitellar somites.

*Penial papilla*.—There are four kinds of glandular cells. Two kinds open into the sperm-duct, while two open into a small pore immediately in front of the spermiducal pore but on the same papilla. There are, however, only three very distinct kinds of glands, as the large glands of the sperm-duct and the large glands of the anterior pore resemble each other so much that they can hardly be distinguished one from the other. The smaller cells of the sperm-duct have oval nuclei. These glands open immediately above the pore, while the larger glands open at the pore but still into the sperm-duct. The small glandular cells of the anterior pore stain darkly and appear to be of a very distinct nature from the others (pl. xv, fig. 6).

#### Genus *Fridericia* Michaelsen.

*Definition*.—Setæ straight; each fascicle contains setæ of different sizes, the larger ones situated outside of the smaller ones. Head-pore



satisfied myself that this is not the case. In several instances I could plainly see that the cilia were attached to the inner membrane.

This can only be explained by supposing that the chylus canal is simply an invagination of the ciliated surface of the cell, and that the object of the cilia is to conduct the chylus as close as possible to the blood sinus at the base of the chylus cell. By means of the canal a much greater surface is exposed to the action of the intestinal juices, and these juices can be quickly and surely brought to a close contact with the blood. In this manner no diminution and weakening of the intestinal wall is necessary, and the same object—that of rapid absorption of the intestinal digested matter—is accomplished with a thick and strongly built intestine. The bottom of the chylus cell rests always on a basement membrane directly in contact with the blood sinus. In order further to increase the contact surface the canal is always bent, and part of it thus runs parallel with the blood sinus. In some species the canal is not only bent, but it is branched and exhibits the form of a bunch of canals, which form must still more facilitate the absorption of the nutritive juice in the intestine. It is probable that these cilia are present in all chylus cells, but it is also certain that they do not extend to the bottom of the canals, but cease a certain distance from the open mouth, generally extending only about half way down the duct. When the canal is bent this bend projects toward the head of the worm, which arrangement would facilitate the driving of the chylus into the canal.

For the various forms of the chylus cells of the respective species I must refer to the description of these species. Here I will only state that the form of the cells is quite varied and characteristic of the species.

The inner lining of the cell is generally bounded on either side by a more or less thick layer of granular cytoplasm. This layer reminds me in many respects of the thick granular layer of the common epithelial cells, which as is well known serves to shut out bacteria and prevents other microbes from entering the cells. This granular layer in the chylus cells probably serves the same purpose, though it may besides have other properties, as for instance, those of a digestive nature. In many species there is no distinct membrane lining the bottom or lower part of the canal, and the granular layer seems to line the lumen. But in some species there is a distinct lining which could not readily be explained except by the theory of invagination. Where the lining is not present we may suppose that an absorption has taken place in that part of the canal. Most of the chylus cells, as first observed by Michaelsen ('86), lean slightly toward the head of the

worm in order to facilitate the absorption of the chylus. On this account a good view of these cells can only be had in longitudinal sections. In transverse sections only part of each cell is cut and exposed, and the nature of the structure cannot be made out.

*Penial bulb*.—The penial bulb of *Fridericia* is quite characteristic and seems to be of similar structure in all the species investigated by the author. There is only one kind of cells filling the bulb. These cells all open in the extension of the sperm-duct and along the surface of the bulb; the duct connects with the bulb at the base of the latter and cannot strictly be said to enter the bulb. The bulb in this species is the simplest of any in this group with distinct bulb.

*Nephridia*.—In all species described here the nephridia are characterized by a large anteseptal, which in size approaches the postseptal part. In not a single instance does the anteseptal consist of only the nephrostome, as, for instance, in the genus *Lumbricillus*.

#### SYNOPSIS OF SPECIES OF FRIDERICIA DESCRIBED IN THIS PAPER.

##### I. Spermathecæ without diverticles.

Brain posteriorly truncate or slightly convex, deltoid. Spermathecal stalk more than twice as long as the ampulla. Peptonephridia with only two branches. Sperm-funnels short, almost globular. Chylus cells in XI, XII and XIII. Duct of chylus cells with a spur pointing forward. Duct lined by a membrane. Very large anteseptal..... 1. *F. harrimani* sp. nov.

Brain posteriorly slightly emarginated. Spermathecal stalk about twice as long as the ampulla which connects with the intestine. Peptonephridia large, conical, with numerous short branches. Chylus cells in X, XI and XII. Duct of chylus with sigmoid, indistinct spur and without a membrane except at its upper end. Anteseptal large ..... 2. *F. johnsoni* sp. nov.

Brain almost circular, posteriorly convex. Spermathecal duct less than twice as long as the ampulla which is connected with the intestine. Peptonephridia with many branches starting from a common base-palmate. Chylus cells in XIV, XV and XVI. The duct is digitate at the lower end, without distinct lining membrane except at the top. Nephridia with long and narrow anteseptal..... 3. *F. fuchsii* sp. nov.

Brain ovoid, posteriorly convex. Spermathecal duct about four times as long as the ampulla which is not connected with the intestine. Chylus cells in XIV, XV and XVI, cells very broad and shallow. Chylus duct sigmoid and much twisted, with a distinct membrane all along its course. Large anteseptal. .... 4. *F. sonoræ* sp. nov.

##### II. Spermathecæ with two diverticles.

Brain circular, posteriorly convex. Diverticles of spermatheca pendent. Chylus cells in XIV, XV and XVI; duct branched, without distinct lining membrane. Nephridial anteseptal thin and comparatively short.

5. *F. santarosæ* sp. nov.

Brain longer than broad, posteriorly convex. Spermathecal diverticles not pendent. Nephridial anteseptal globular and strongly granulated; unusually thick canal ..... 6. *F. santæbarbaræ* sp. nov.

Brain longer than broad, posteriorly convex. Spermathecal diverticles narrow, short, and pendent. Nephridial anteseptal large, deltoid, with few coarse granules ..... 7. *F. popofiana* sp. nov.



### III. Spermatheca with many diverticles around the ampulla.

Brain ovoid, posteriorly convex. Spermathecal diverticles of unequal size. Chylus cells in XIV, XV and XVI; ducts twisted; lower part without distinct lining membrane. Nephridial anteseptal very large, ovoid, without granulation at the nephropore..... 8. *F. macgregori* sp. nov.

Brain deltoid, posteriorly convex. Spermathecal diverticles of unequal size. Chylus cells in XIV, XV and XVI with a short spur. Nephridial anteseptal large, contracted at the center ..... 9. *F. californica* sp. nov.

## FRIDERICIA HARRIMANI sp. nov.

Pl. xx, figs. 3-5; text-figs. 70 and 71.

*Definition.*—Length 6 mm., width .5 mm. Somites 35 to 40, with deep intersegmental grooves. Prostomium blunt. Setæ: ventrals about 6 in each ventral fascicle and about 5 in the lateral ones anterior to clitellum. The inner setæ much thinner than the outer ones. Dorsal pores normal. Head pore between prostomium and somite I. Clitellum XII and XIII, not prominent. Sexual papillæ small. Septal glands normal. Peptonephridia short, each with at least two branches starting from the base of the gland. Brain deltoid, posteriorly broader than anteriorly; posterior margin almost straight; the anterior margin conical. Dorsal vessel rises in XIV. Blood strongly crystallizable. Intestine with numerous and thick chloragogen cells containing large granules. Chylus cells in XI, XII and XIII. Spermatheca with long narrow duct and deltoid pouch opening into the intestine. No diverticles. Sperm-funnels short, cubical, four times as long as funnels.? Nephridia with an enormous anteseptal about as large as the postseptal middle lobe. Lymphocytes not known. Color of body white.

*Locality.*—In decaying timber at Mountain View, California, Prof. E. M. Ehrhorn.

*Characteristics.*—This interesting species belongs to the group of *Fridericia sonora* and *F. fuchsi*, characterized by absence of spermathecal diverticles. From both these species it is distinguished by the unusually large anteseptal of the nephridia.

### DETAILED DESCRIPTION.

*Brain.*—This organ varies somewhat. In the majority of the specimens opened it was distinctly deltoid, being broader posteriorly than anteriorly. One specimen, however, possessed a brain with sides nearly parallel. The posterior margin is more or less truncate, never strongly convex.

*Blood.*—The blood in all the specimens (fixed with the bichromate acetic) was so highly crystallized that no good and perfect sections



could be had. The crystals were unequally distributed, in some places filling the whole vessel, while in other parts none were to be seen. They were so hard that the edge of the section knife would break at once. Similarly crystallized hemoglobin has not been observed in any

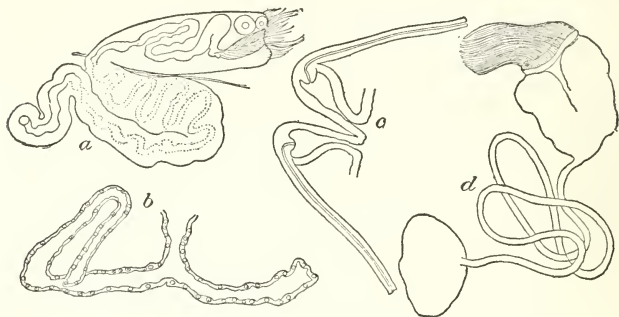


FIG. 70. *Fridericia harrimani*.

other Enchytraeid. It is always present in *Sparganophilus*, as commented on by both Benham and myself. The crystals in the present species are found in all the vessels, capillaries, dorsals, and ventrals.

*Chylus cells*.—In several longitudinally sectioned specimens these cells were found in somites XI to XIII. The intestine in these somites

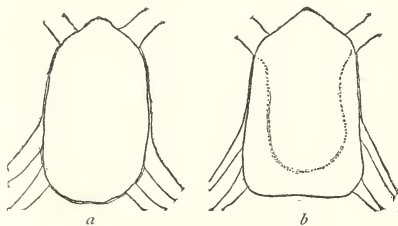


FIG. 71. *Fridericia harrimani*.

is differentiated into a crop consisting of a layer of chylus cells separated in the usual manner by epithelial cells and interstitial cells. The arrangement is a most regular one. Seen in a thin median section passing between the dorsal vessel and the ventral ganglion, and in

the longitudinal diameter of the body, we find that the chylus cells are cut through perpendicularly and that each such cell is separated by about two epithelial cells and by one or two interstitial cells. In other words, the chylus cells are placed at regular intervals, the same distance being kept between each two of them in all the three somites. The canal in this species is lined by a distinct membrane which is ciliated along its

upper course near the mouth. The immediate vicinity of the membrane is crowded with granules which stain deeply with eosin, the deeper the nearer the membrane. The lower part of the canal is bent at a right angle to the upper part, and the spur thus formed is in all the cells invariably pointing toward the head of the worm.

*Penial bulb.*—This organ contains only one kind of cell, though some cells open in the extension of the sperm-duct and others along the free surface of the bulb. The duct enters the bulb near the base. pl. xx, fig. 4, represents the bulb as seen in a section transverse to the body. In a longitudinal section it would probably appear just as in pl. xv, fig. 8, representing the bulb of *F. californica*.

*Nephridia.*—The anteseptal is probably the largest of any observed so far. In some nephridia this part was fully as large as the post-septal lobe. The ciliated part of the nephrostome is quite small. A tortuous, uneven duct runs down from this ciliated chamber to the postseptal.

FRIDERICIA JOHNSONI sp. nov.

pl. xvi, fig. 6; text-fig. 72.

*Definition.*—Length 8 mm., width .5 mm. Somites 45 to 48. Prostomium blunt. Dorsal pores begin in VII. Setæ of unequal length, the inner ones much shorter; five and four setæ in the anterior and central fascicles. Head-pore between prostomium and somite I. Clitellum not prominent in XII and XIII. Sexual papillæ small. Anterior septa slightly thicker than those posterior to clitellum. Septal glands in IV, V and VI. Supra-pharyngeal glands small. Peptonephridia thick and compact, with the free end frayed. Brain longer than wide, with the posterior margin slightly concave. The anterior retractor muscles of the brain are situated far forward. Dorsal vessel rises in XIII. Intestine narrow, widening in XIII. Intestine commencing with XIII is covered with a thick layer of very tall chloragogen cells. In the anterior somites these cells are very low and few. Chylus cells in X, XI and XII, none posterior to clitellum. Spermathecae with a club-shaped apical ampulla connecting with the intestine; no diverticles. Penial bulb with two kinds of glandular cells; those opening at the base of the sperm-duct are the largest. Nephridia with large non-glandular anteseptal in which the duct is spirally wound. The large lymphocytes are disc-like and almost circular. Color white.

*Locality.*—Garden of Ellwood Cooper, at Ellwood, near Santa Barbara, California, May, 1898. Named for Prof. Herbert P. John-

son, the well-known zoologist, to whom I am indebted for several interesting Oligochæta.

*Characteristics.*—This species is characterized by its spermathecae without diverticles and by the position of its chylus cells in somites X, XI and XII. In most other species the chylus cells are found in somites posterior to clitellum.

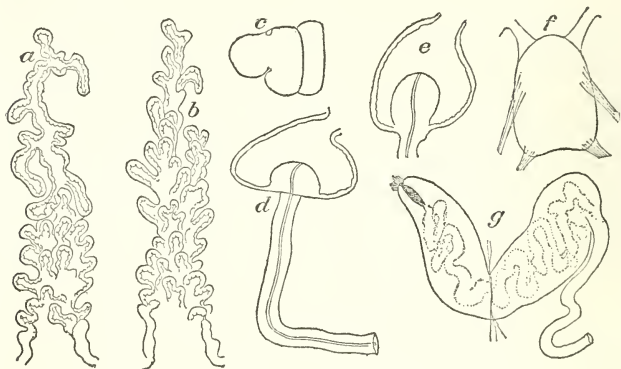


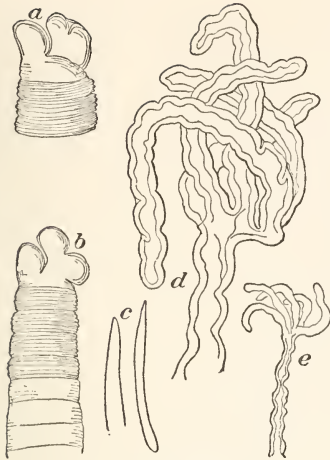
FIG. 72. *Fridericia johnsoni*.

*Chylus cells.*—The unusual position of these cells has just been mentioned. The cells are long and narrow, with somewhat warty surface. The nucleus is oval, situated below the center of the cell. The chylus cells are separated by rows of single epithelial cells. The latter with round nuclei.

#### FRIDERICIA FUCHSI sp. nov.

pl. xvii, figs. 1-3; text-figs. 73 and 74.

*Definition.*—Length 18 mm., width .5 mm. Somites about 65. Setae slightly curved, more so in the anterior somites than in the posterior ones, in fascicles of four and five, the inner setae being much shorter. Dorsal pores commence with VII. Head-pore between prostomium and somite I. Prostomium prominent. Sexual papillae small. Septal glands large, IV to VI. Peptonephridia with from four to six branches projecting from a common base. Brain almost circular, convex posteriorly and anteriorly. Dorsal vessel rises posterior to clitellum. Intestine with a thin layer of chloragogen cells. Chylus cells in XIV to XVI, long and narrow, separated by very

FIG. 73. *Fridericia fuchsi*.

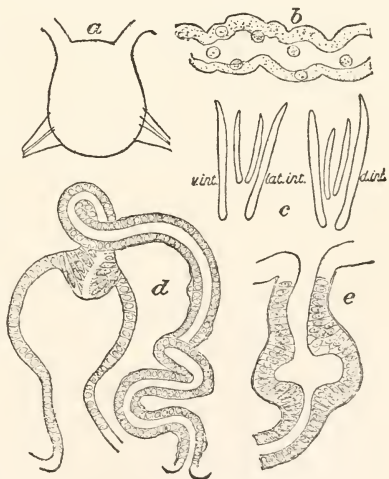
broad and shallow epithelial cells. Spermatheca with a sac-like apical pouch, without diverticles; connects with the intestine, the stem of the spermatheca much twisted. Penial bulb small, with cells opening both into the sperm-duct and at the base of the papilla. Lymphocytes round, disc-like. Nephridia with a long and narrow anteseptal. Color yellowish-white.

*Locality*.—Santa Cruz Mountains near Boulder Creek, on ranch of Mr. Koester, Prof. Charles Fuchs.

*Characteristics*.—Exteriorly the species is readily distinguished. The anterior four to

six somites are deeply multi-ringed, while all those posterior are perfectly smooth, so smooth that no distinction is seen between the respective somites. The last few somites of the tail are, however, separated by distinct grooves. The nearest related species is *F. sonora*, but this latter species has free spermathecae, while in *F. fuchsi* the spermathecae open into the intestine.

*Chylus cells* (Pl. XVII, fig. 2).—These cells, which occur in three somites posterior to clitellum, are long and narrow. The inner duct is digitate at the base. The chylus cells

FIG. 74. *Fridericia fuchsi*.

are separated by epithelial cells which greatly resemble those of *F. sonora*. Below the epithelial cells are seen broad interstitial cells with large meshes of cytoplasm. It is to be noted that *F. fuchsi* and *F. sonora* also resemble each other in the form of the spermathecæ and in the absence of spermathecal diverticles. These two species differ from all others so far examined by me, by the long and flat epithelial cells of the intestine. In *F. sonora* the chylus cells are not as high.

*Muscular layer*.—The outer muscular layer of the body-wall is quite characteristic. It rises at certain short intervals into the epithelium, almost completely separating these cells. In cross-section these strands are triangular, with the apex pointing toward the cuticle.

### FRIDERICIA SONORÆ sp. nov.

Pl. XVI, figs. 1-3; text-fig. 75.

*Definition*.—Length 12 mm., width .5 mm. Somites about 40. Setæ in bunches, anteriorly of 6, posteriorly of 5, 4 and 3. The outer ones are much larger than the inner ones. Prostomium small and pointed. Clitellum XII and XIII. Sexual papillæ small. Brain ovoid. Dorsal vessel rises posterior to clitellum. Intestine with chylus cells in the two or three somites next posterior to clitellum. Spermathecæ with a large globular ampulla which does not connect with the intestine. Penial bulb small, with a single row of glands opening

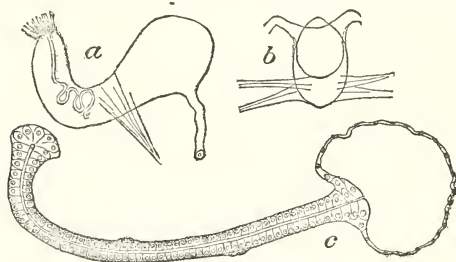


FIG. 75. *Fridericia sonora*.

into the lower part of the sperm-duct, which latter is not dilated. Lymphocytes of two kinds, the large ones small, oval, of a diameter equaling that of two or three muscular strands. The microcytes are from one diameter

to half the diameter of a muscular strand. Color pale yellowish-white without pigment. Nephridia with a very large anteseptal.

*Locality*.—San Miguel de Horcasitas, Sonora, Mexico, in soft banks of irrigation ditches, May, 1893. Four small specimens, all containing sand, causing the loss of many sections. The salivary

glands, which appear to be simple, could not be made out distinctly enough to be described.

#### DETAILED DESCRIPTION.

*Spermathecæ* are small and closely pressed to the body-wall. They do not connect with the intestine. There are no diverticles. The ampulla is thin-walled, with a single row of cells.

*Penial bulb* is small and contains about one tier of cells. The sperm-duct enters on the lateral side of the bulb, next to the lateral body-wall.

*Chylus cells*.—The intestine next posterior to the clitellum contains a continuous row of chylus cells containing chylus ducts. The cells containing the ducts are very large and with a large nucleus. The part of the cell opening into the intestinal cavity is drawn out like the neck of a bottle. The ducts are different from those of any other species. Each duct is surrounded by a thick wall, outside of which is a thick body of granular cytoplasm. The duct twists around in the cell but does not connect with ducts of other cells. These chylus cells do not directly line the intestine but are overlapped by an inner epithelial layer of cells which are strongly ciliated and between which the necks of the chylus cells open in the intestine.

#### FRIDERICIA SANTÆROSÆ sp. nov.

pl. xvi, figs. 4 and 5; text-fig. 76.

*Definition*.—Length 14 to 20 mm., width .75 mm. Somites about 60 to 64. Setæ of unequal length, the interior ones much smaller. Prostomium small, but pointed and prominent. Clitellum not prominent, XII and XIII. Male papillæ small, cube-shaped. Peptonephridia with four to six narrow tubules from a thick, elongated base. Brain posteriorly rounded, or with a very slight emargination. Dorsal vessel rises in XV. Intestine and dorsal vessel covered with a thick layer of tall chloragogen glands. Chylus cells in XIV, XV and XVI. Spermathecæ with two diverticles each, and with long cylindrical duct; distal part connected with the intestine. Sperm-funnels longer than broad, with a lobate base. Penial bulb small, containing a single row of glandular cells opening along the base of the bulb. Nephridia with a long narrow postseptal and a shorter narrow anteseptal. Lymphocytes large, elliptical. Color of alcoholic specimens yellowish. No pigment.

*Locality*.—Santa Rosa, Sonoma County, California. Common under oak trees near the city. Many adult specimens in May, 1893.

*Chylus cells* in the somites posterior to clitellum are long and narrow, and open between larger ciliated epithelial cells.

*Setæ* are in fascicles of from four to six. The inner ones are shorter. Sometimes there are three *setæ* in one-half of the fascicle and only two in the other.

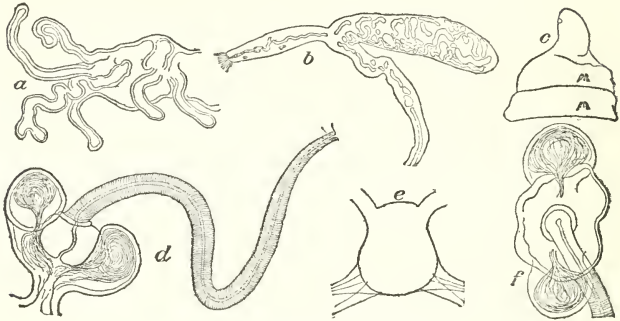


FIG. 76. *Fridericia santarosæ*.

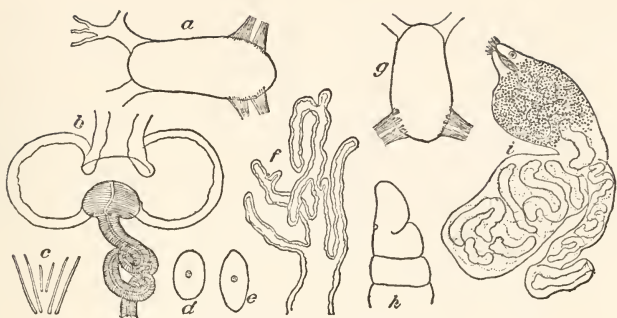
*Spermatheca* contains as a rule only two large diverticles, but in one specimen I found the large diverticle of one side replaced by three smaller ones.

#### FRIDERICIA SANTÆBARBARÆ sp. nov.

Text-fig. 77.

*Definition.*—Length 10 to 12 mm., width .5 mm. Somites about 55. *Setæ* of unequal length, 4, 5, and 6 in a fascicle, the inner ones much shorter and narrower. Dorsal pores present. Head-pore between prostomium and somite I. Clitellum XII and XIII. Sexual papillæ small. Peptonephridia with several irregular tubes. Brain from one and a half to two times as long as wide, and posteriorly and anteriorly convex. Intestine with a thin layer of shallow chloragogen cells. Spermathecae, with two large diverticles, connect with the intestine. The penial bulb with two sets of glands opens respectively into the base of the sperm-duct and along the base of the bulb. No accessory penial glands and no prostate glands. Nephridia large. Anteseptal large and swollen and filled with opaque granules; anteseptal with a winding duct. Lymphocytes of two kinds, the larger kind ellipsoidal, with or without pointed ends. Color white.



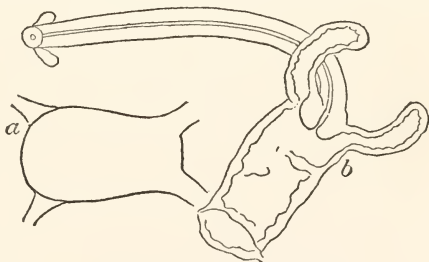
FIG. 77. *Fridericia santabarbaræ*.

*Locality*.—Two specimens from Santa Barbara, California, May, 1898. In garden soil. The specimens being in poor state of preservation made it impossible to ascertain the structure of the chylus cells.

#### FRIDERICIA POPOFIANA sp. nov.

Text-figs. 78 and 79.

*Definition*.—Length about 18 mm., width .5 mm. Somites over 45. Setæ four in a fascicle, the inner ones smaller. Prostomium blunt, rounded, slightly rugose. Clitellum small, not prominent, XII and XIII. Copulatory papillæ small. Peptonephridia with thick and rather short body, at the apex of which are found four or five branches of smaller lobes. Brain longer than broad, anteriorly straight, posteriorly convex. Spermatheca with a cylindrical thick ampulla which connects with the intestine by a broad opening. The narrow duct is about one-half longer than the pouch, and from one-half to one-third as thick. There are two diverticles at the base of the

FIG. 78. *Fridericia popofiana*.

pouch. These are about one-half as long as the pouch and slightly wider than the duct. Nephridia oblong with a very long and broad anteseptal, almost equal in size to the postseptal less the duct. The

duct leaves the nephridium at the center. Color white, very transparent. Integument thin.

*Locality.*—Popof Island, Shumagin group, Alaska, Prof. Trevor Kincaid. A single specimen. Several of the posterior somites missing. No attempt at sectioning was made.



FIG. 79. *Fridericia popofiana*.

*Characteristics.*—The spermathecae are the most characteristic parts and must suffice to distinguish the species until more material will allow of sectioning and show the nature of the chylus cells, now unknown.

#### FRIDERICIA MACGREGORI sp. nov.

pl. xvii, figs. 4, 5; text-fig. 80.

*Definition.*—Length about 8 mm., width .5 mm. Somites about 45. Setae in fascicles: laterals, 4, 4, 5, 5, 0, 6, 7, 6, 5, 4; ventrals, 5, 6, 7, 7, 0, 7, 8, 7, 6, 5, 5, 4. The largest setae in each bundle are found bordering the dorsal and ventral intervals. Head-pore between prostomium and somite I. Prostomium slightly pointed. Clitellum not prominent. Sexual papillae small. Septal glands large, in IV, V, and VI. Peptonephridia with six or seven simple branches projecting from a common base. Brain anteriorly much convex, posteriorly slightly so. Dorsal vessel rises in XV. Intestine with large chloragogen cells; in XIV to XVI furnished with numerous long and narrow chylus cells. Spermathecae with a long tapering muscular duct, and a globular ampulla furnished with about eight diverticles, two of the latter being larger than the others; opens into the intestine. Sperm-ducts narrow, closely wound and confined to the clitellum.

Two sets of glands in the penial bulb. Nephridia with large anteseptal, not strongly granulated. Lymphocytes large, ovoid. Color pale, transparent white.

*Locality.* — In rotten logs at Saint Helena, Napa County, California. Collected by Dr. Richard C. McGregor in 1899.

*Characteristics.* — The most characteristic feature is the arrangement of the setæ. These are large, and those facing the ventral and dorsal intervals are markedly larger than the others. The spermathecae resemble those of *F. californica*, but the proportion of stem to ampulla is different; the shape of the stem is also different in the two species.

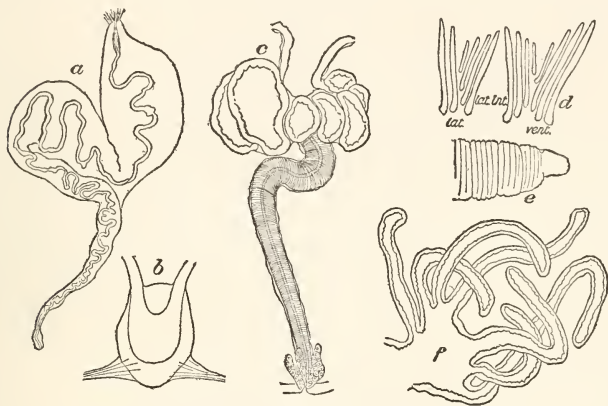


FIG. 80. *Fridericia macgregori*.

From *F. californica* our present species also differs in the form of the nephridia and in the shape of the salivary glands.

The *chylus cells* in the intestine are long, narrow, and are characterized by the lower part of the inner duct being spirally twisted or at least strongly sigmoid. The duct is lined with a regular and even layer of thin cytoplasm, exterior to which is a thicker layer of denser cytoplasm, capable of very dense staining.

#### FRIDERICIA CALIFORNICA sp. nov.

pl. xv, figs. 8, 9; text-fig. 81.

*Definition.* — Length 22 mm., width .5 mm. Somites 70. Setæ anteriorly 5 and 6 in each bundle, posteriorly 6 and 4 of three different sizes. Head-pore large, between prostomium and somite I. Pro-

stomium short, rounded. Clitellum not prominent, XII and XIII. Sexual papillæ small. Septal glands large, in IV to VI. Peptonephridia open in IV, end in V, narrow, slightly and irregularly branched. Brain anteriorly and posteriorly convex, ovoid. Dorsal vessel rises in XVI. Intestine narrow and tubular, changing into sacculated intestine in XIV. Spermathecæ with a row of six or seven bladder-like diverticles around the ampulla; two small accessory glands at the base of the muscular duct. Sperm-ducts long, narrow, with a small penial bulb, in which is found a set of small glands. No other penial glands. Sperm-funnels cylindrical, straight, about twice as long as broad.

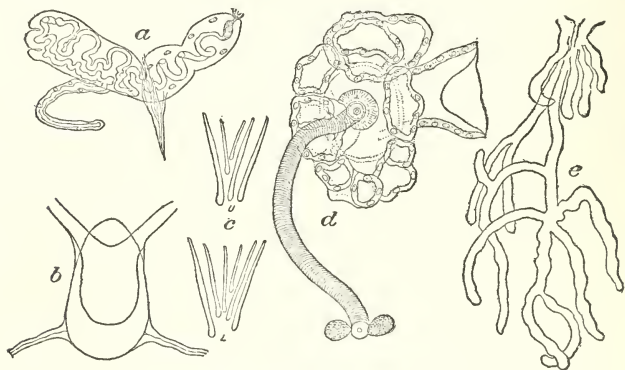


FIG. 81. *Fridericia californica*.

Nephridia with a large anteseptal, frequently contracted at center, and with a straight duct. Lymphocytes of two kinds; the larger cyanophil, the smaller with erythrophil nucleus. Color pale yellowish white.

*Locality*.—In moist soil around Laguna Puerca, near San Francisco, California.

#### DETAILED DESCRIPTION.

*Spermathecæ*.—The diverticles are large and with irregular outlines. Generally one or two diverticles are larger than the others. The duct is even, slightly bent, and somewhat longer than the ampulla. The latter opens into the intestine. The two small glands at the base of the duct are about as wide as the duct.

*Penial bulb*.—There is only one kind of gland composing the penial bulb. The sperm-ducts enter the bulb near the base, splitting the bulb into two unequal parts.

Ovaries extend as far back as XV and XVI.

The *nephridia* are long and the anteseptal part is nearly equal in length to the postseptal part. The anteseptal is divided transversely into two nearly equal, globular parts. The nephrostome is small. The postseptal part is long and rectangular, with crenate edge. The duct in the anteseptal is spirally wound. Only the part nearest the nephrostome is ciliated.

*Lymphocytes*.—The larger kind is round, transparent, and its nucleus stains blue. The smaller kind is also round and transparent, but its nucleus stains reddish with eosin-thionin.

*Setæ*.—The setæ in each bundle are frequently of odd numbers. Thus one bundle may have on one side three setæ and on the other only one, or there may be three on one side and only two on the other. The central setæ are always the smallest. When setæ are wanting on one side it is always the small setæ which are missing.

*Chylus cells*.—In the three somites next posterior to the clitellum, the intestine possesses numerous chylus cells, separated by common ciliated epithelial cells. These chylus cells are long and comparatively narrow, each containing a single duct. The duct is perpendicular to the base of the cell, except at the very base, where the duct is bent, running parallel with the basal membrane. The duct is surrounded by a thin layer of granular dense cytoplasm. The interior of the duct is ciliated along its upper course.

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## ABBREVIATIONS USED IN TEXT FIGURES.

The following abbreviations are used in connection with the text illustrations :

*ac. gl.*, accessory glands opening exterior to the penial bulb near the spermiducal pore.

*atr.*, atrium of the sperm-duct.

*at. gl.*, atrial glands or prostate opening into the atrium of the sperm-duct.

*b. w.*, body-wall or integument.

*d. int.*, dorsal interval, the interval between the dorsal fascicles of setæ.

*gl. c.*, glandular cells opening into the spermatheca.

*gl. ep.*, glandular epithelium.

*int.*, intestine, or in some instances the place where the spermatheca opens into the intestine.

*l. m.*, longitudinal muscular layer of the body-wall.

*lat. int.*, lateral interval; the interval between the ventral and lateral fascicles of setæ.

*or. ac. gl.*, orifice of the accessory glands opening outside of the penial bulb near the spermiducal pore.

*p. blb.*, penial bulb, the glandular and muscular cushion which surrounds the penial pore, and which projects inward in the cœlomic cavity.

*p. gl.*, penial glands, glands which are situated inside the penial bulb and which generally open on the surface of the body around the penial pore.

*pr.*, prostate or accessory glands opening into atrium of the sperm-duct.

*pore*, the penial pore, the exterior pore of the sperm-duct. Also pore of spermatheca.

*spd.*, sperm-duct, the duct between the sperm-funnel and the atrium.

*spd. p.*, spermiducal pore; the exterior pore of the sperm-duct.

*sp. f.*, sperm-funnel.

*spth.*, spermatheca.

*sp.*, sperm-sacs capping the testes in *Lumbricillus*.

*t.*, testes.

*t. c.*, tactile cells.

*tr. m.*, transverse muscular layer.

*v. int.*, ventral interval, the interval between the ventral fascicles of setæ.

## ABBREVIATIONS USED IN THE PLATES.

- ac.gl.*, accessory glands of the spermiducal apparatus.  
*at.gl.*, atrial glands.  
*atr.*, atrium.  
*br.*, brain.  
*c.m.*, circular muscles surrounding the ducts of the atrial glands.  
*cr.m.*, circular muscles.  
*chyl.*, chylus cells in the intestine.  
*cutic.*, cuticle.  
*d.at.gl.*, ducts of the atrial glands.  
*d.v.*, dorsal vessel.  
*div.*, diverticle of spermatheca or intestine.  
*ducts*, ducts of atrial glands.  
*ep.*, epithelial cells.  
*epith.*, epithelium.  
*glg.*, ganglion.  
*gln.*, ganglion inclosed in septal glands.  
*gl.c.*, glandular cells.  
*gl.d.*, ducts of atrial glands.  
*i.p.gl.*, intra-penial glands.  
*int.*, intestine.  
*l.ch.*, lower chamber or penial chamber of the sperm-duct.  
*m.*, muscles.  
*p.blb.*, penial bulb.  
*p.gl.*, penial glands.  
*p.pap.*, penial papillæ in *Enchytraeus*.  
*p.ch.*, penial chamber in the lower part of the sperm-duct.  
*p.pore*, penial pore.  
*s.*, septum.  
*sp.d.*, sperm-duct.  
*spth.*, spermatheca.  
*spth.p.*, spermathecal pore.  
*sp.s.*, sperm-sacs at the ends of the testes.  
*sep.gl.*, septal glands.  
*t.*, testes.

*Note.*—The finer details of all the preparations were studied with Zeiss Apo. 3 mm., Apt. 1:40. Ocs. 8 and 12. Sections cut in paraffin and mounted in Thus. Xylol. Staining with eosin in alcohol and methylen blue 'o' or with thionin.

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## PLATE I.

### *Mesenchytræus harrimani* sp. nov.

- FIG. 1. Cyanophil lymphocyte, with granules surrounded by a narrow zone of eosinophil cytoplasm.
2. Cyanophil lymphocyte of the same nature as the foregoing, but of a broader form.
  3. Cyanophil lymphocytes in which eosinophil granules are being formed in the zone surrounding the cyanophil granules.
  4. Eosinophil lymphocyte with foamy cytoplasm. In some of these minute chambers eosinophil granules are being formed.
  5. Eosinophil lymphocytes in which the formation of granules has progressed farther than in the cell represented in the last figure.
  6. Eosinophil lymphocyte in which the eosinophil granules have reached their final size. In this stage the granules are thrown out into the cytoplasm.

### *Mesenchytræus unalaska* sp. nov.

7. Eosinophil lymphocyte with foamy cytoplasm and eosinophil granules.

### *Mesenchytræus grandis* sp. nov.

8. Cyanophil lymphocytes with the granules surrounded by a narrow zone of eosinophil secretion.
- 9, 10. Eosinophil lymphocytes.

### *Mesenchytræus setchelli* sp. nov.

11. Cyanophil lymphocyte.

### *Mesenchytræus eastwoodi* sp. nov.

12. Cyanophil lymphocyte.

### *Mesenchytræus pedatus* sp. nov.

- 13, 14. Cyanophil lymphocytes.

### *Mesenchytræus fontinalis* sp. nov.

15. Cyanophil lymphocyte.

### *Mesenchytræus kincaidi* sp. nov.

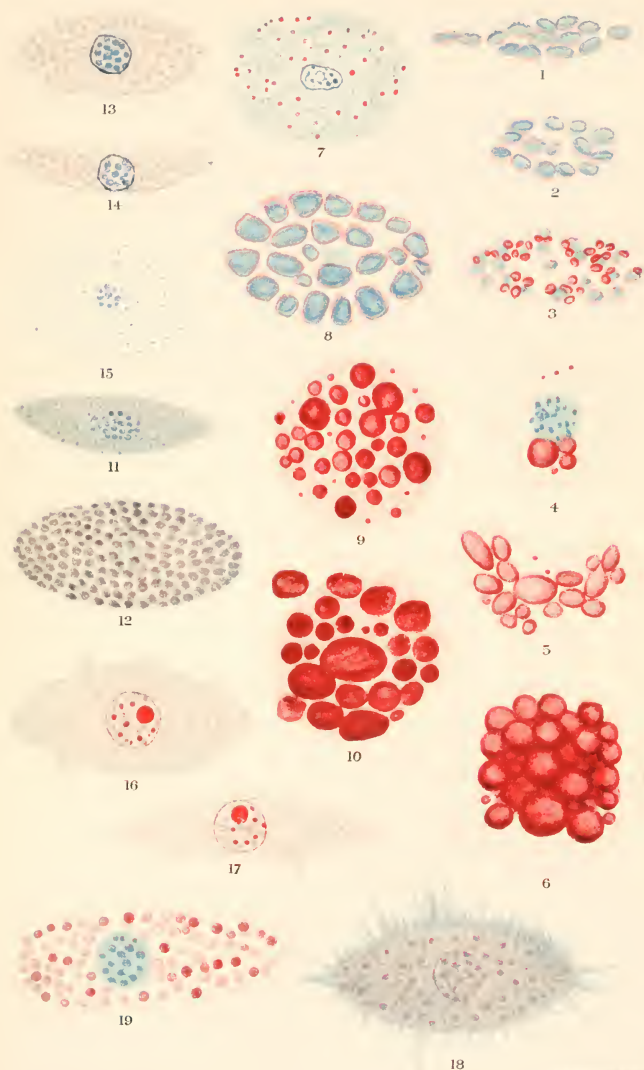
- 16, 17. Lymphocytes with foamy cytoplasm and without granulations. The margin shows cytoplasmic projections.

### *Mesenchytræus fuscus inermis* subsp. nov.

18. Cyanophil lymphocyte with radiate margin.

### *Enchytræus alaska* sp. nov.

19. Eosinophil lymphocyte with numerous globular granulations.



GUSTAV EISEN, DEL.

## ENCHYTRÆIDÆ

MESENCHYTRÆUS HARRIMANI 1 to 6

MESENCHYTRÆUS GRANDIS 8, 9, 10

MESENCHYTRÆUS EASTWOODI 12

MESENCHYTRÆUS FONTINALIS 15

MESENCHYTRÆUS FUSCUS INERMIS 18

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MESENCHYTRÆUS PEDATUS 13, 14

MESENCHYTRÆUS KINCAIDII 16, 17

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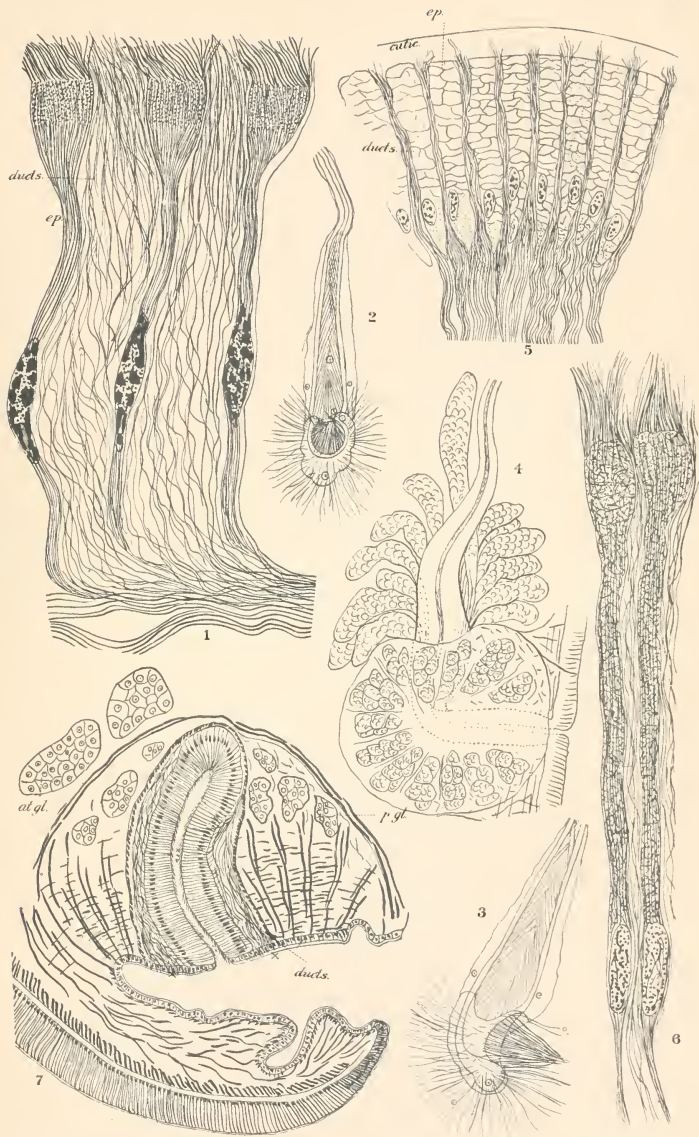




## PLATE II.

### *Mesenchytraeus harrimani* sp. nov.

- FIG. 1. Section through some epithelial cells lining the inner surface of the sperm-duct at a point marked *xx*, near the opening of the pore.
2. Nephrostome, viewed from the flat or ventral side.
3. Nephrostome, side view.
4. Diagrammatic view of the lower part of the male apparatus, from dissection. The atrial glands are seen to be confined to one side of sperm-duct. The arrangement of the glands in the bulb is merely indicated. The bulb is thick and globular and quite opaque.
5. Section through part of the epithelium near the male-pore from a point marked *x*. The epithelial cells are separated by the narrow ducts of the unicellular glands composing the atrial gland. These ducts open between the epithelial cells. Other ducts open in the lumen of the sperm-duct.
6. Section through the epithelial cells lining the inner surface of the sperm-duct at a point marked *xxx*. The epithelial cells are here thin and long and not situated close together. They are furnished with long cilia. The narrow ducts from the atrial glands are seen to open between the epithelial cells.
7. Section through the male-pore. Low magnification.



## ENCHYTRÆIDÆ

MESENCHYTRÆUS HARRIMANI, 1. TO 7.

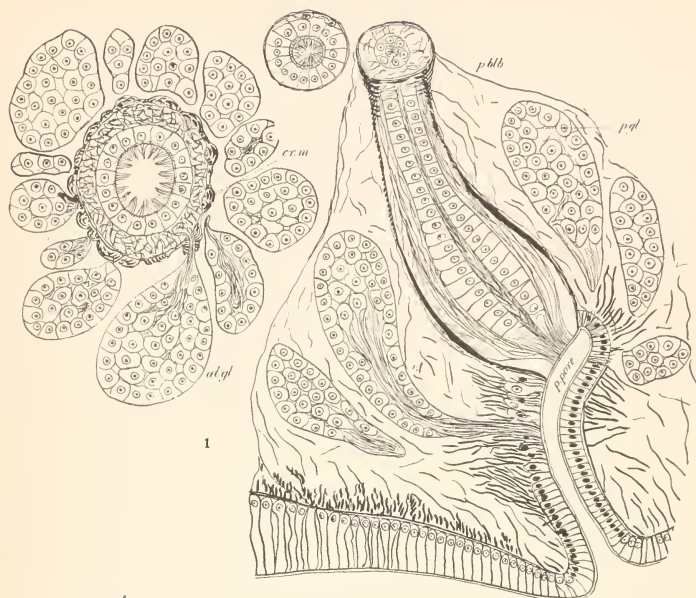




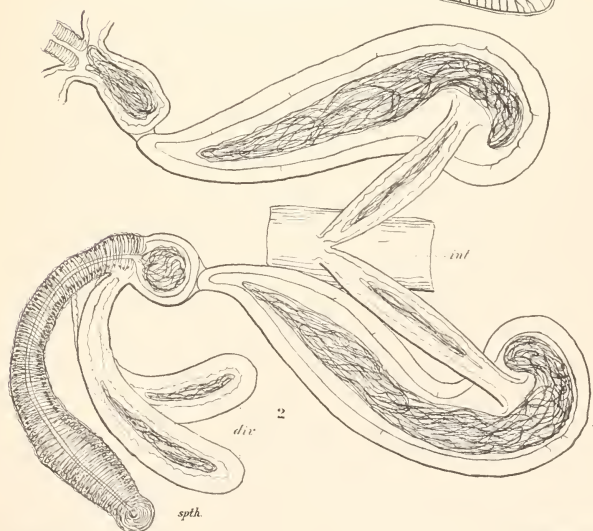
### PLATE III.

#### *Mesenchytræus vegæ* sp. nov.

- FIG. 1. The spermathecal apparatus. A part of one of the spermathecæ is not figured. The spermathecæ are connected with the intestine by a narrow duct.
2. A transverse section of the body passing through the penial bulb, atrium, atrial glands, and sperm-duct. One atrial gland is seen to enter the atrium. There are twelve to fourteen ducts of atrial glands leading into the atrium, each duct being surrounded by circular muscles.



1



2

## ENCHYTRÆIDÆ

MISENCHYTRÆUS VEGAT. 7. 12







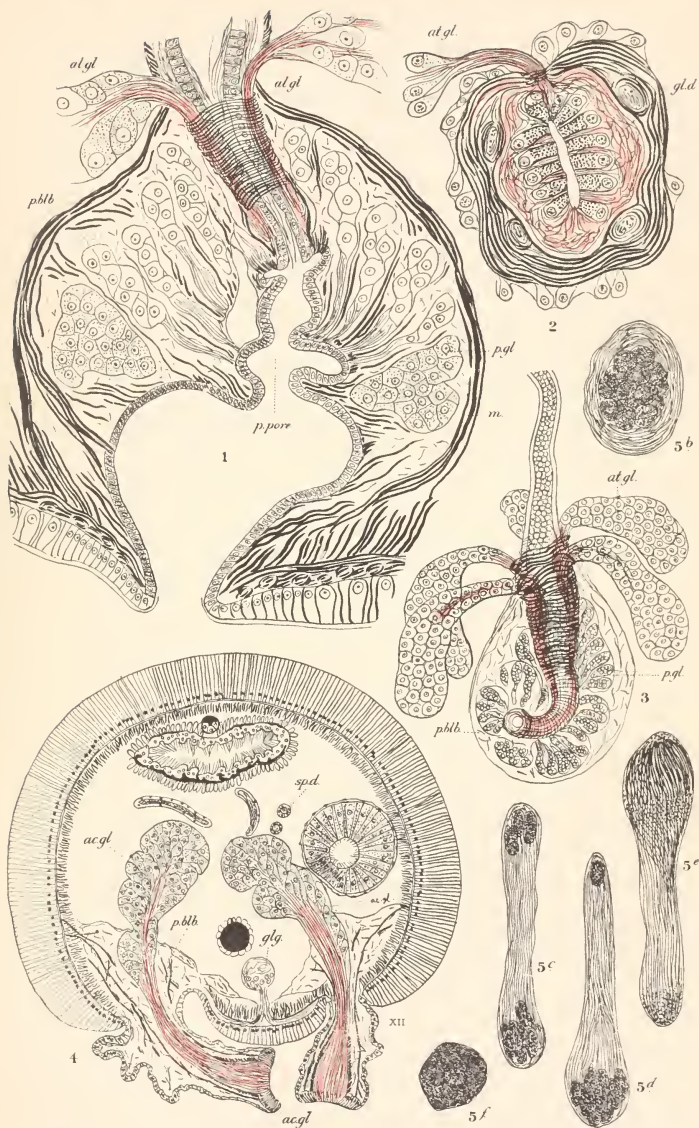
## PLATE IV.

### *Mesenchytræus setchelli* sp. nov.

- FIG. 1. Section through the penial bulb and pore, showing the long ducts of the atrial glands opening near the pore. A band of circular muscles surround the atrium inside the penial bulb. This figure is held somewhat diagrammatic.
2. Section through the upper part of the atrium, showing the entrance of one atrial gland and the ducts of four other atrial glands.
3. Atrium of sperm-duct with five atrial glands. Somewhat diagrammatic.

### *Mesenchytræus franciscanus* sp. nov.

4. Section through the body in somite XII, passing through the large accessory glands. The pores of the sperm-ducts, and the atrium, etc. are cut by several sections posterior to this one.
- 5*b*, 5*c*, 5*d*, 5*e* and 5*f*. Spermatophores in various stages of development.



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ENCHYTRÆIDÆ

MESENCHYTRÆUS SETCHELLI. 1, 2, 3  
MESENCHYTRÆUS FRANCISCANUS. 4, 5

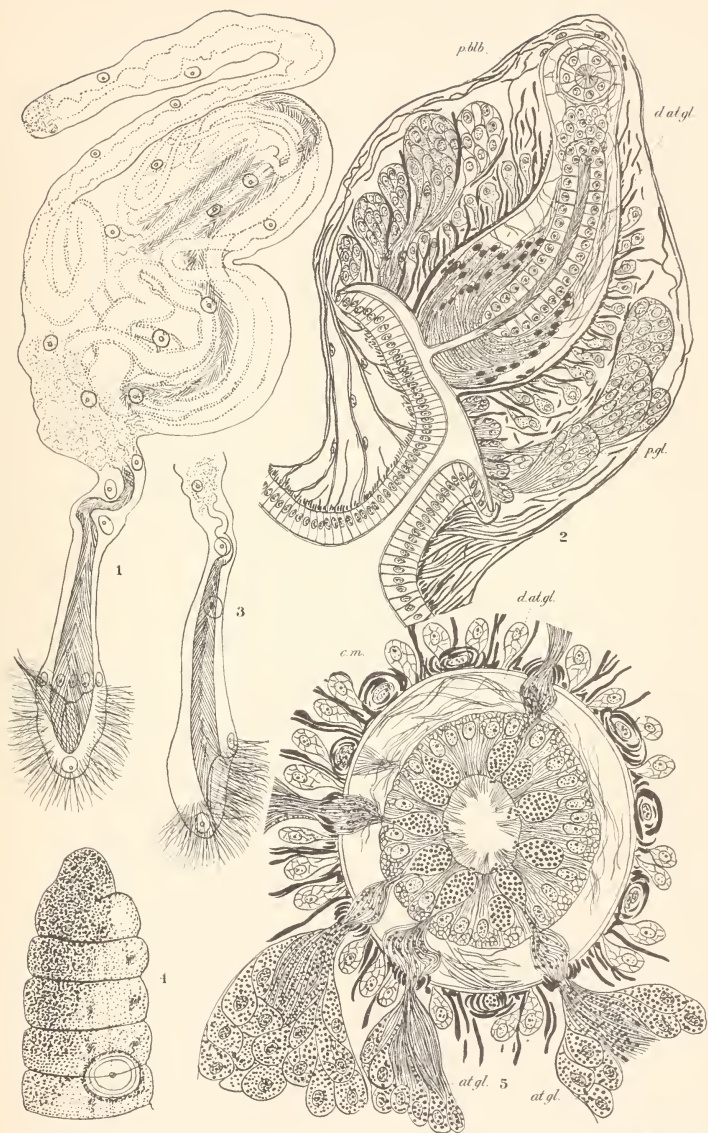




## PLATE V.

### *Mesenchytræus maculatus* sp. nov.

- FIG. 1. Nephridium.  
2. Penial bulb and chamber, from a transverse section of the body.  
3. Nephrostome, side view.  
4. Anterior somites, side view. The large white shield is an unpigmented field surrounding the spermathecal pore.  
5. Atrium, just outside of the penial bulb, from a cross-section of the body. Only two of the atrial gland fascicles are partly delineated. Their ducts are seen to open into chambers situated between the epithelial cells. These pockets are filled with eosinophil granulations from the glands.



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## ENCHYTRÆIDÆ

MESENCHYTRÆUS MACULATUS 1. 2. 3. 4. 5.







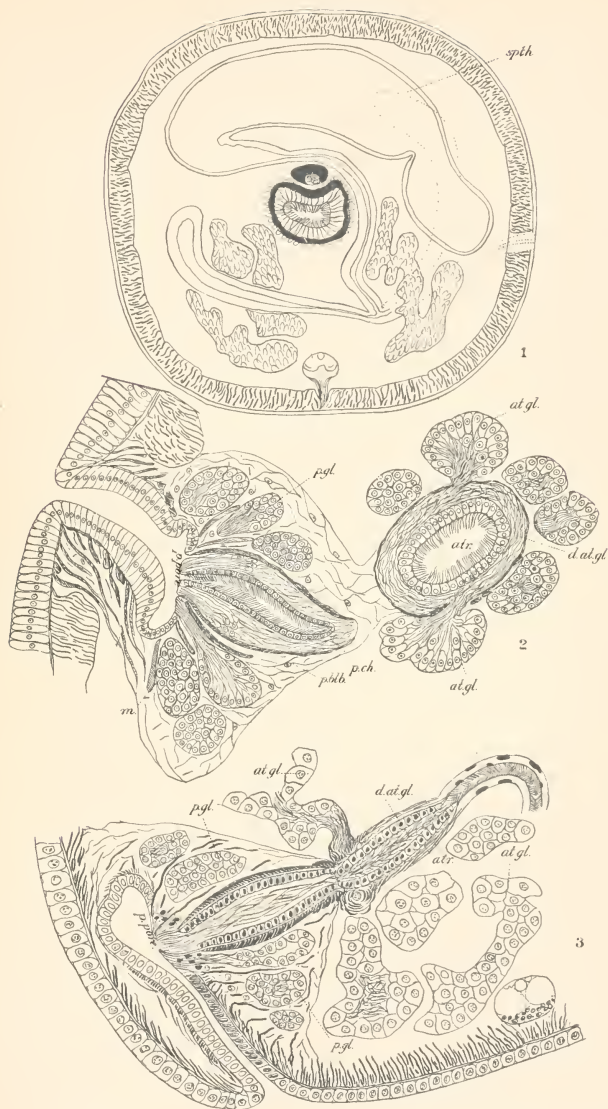
## PLATE VI.

### *Mesenchytræus obscurus* sp. nov.

- FIG. 1. Section through the spermathecal somite, illustrating the relative size of the spermathecæ. Section passes through only one of the spermathecæ.
2. Section through the body-wall of the male-pore. *at.gl.*, atrial glands scattered irregularly all around the atrium and opening into its inner chamber; *atr.*, atrium and sperm-ducts; *p.blb.*, penial bulb; *p.gl.*, penial glands inside the penial bulb, opening at the pore; *spd.*, sperm-duct connecting ultimately with the funnel.

### *Mesenchytræus eastwoodi* sp. nov.

3. The male spermiducal apparatus. There are two atrial glands opening into the atrium close to its base and adjoining the penial bulb. *atr.*, atrium; *d.at.gl.*, ducts of atrial glands; *at.gl.*, atrial glands; *p.gl.*, penial glands opening in the penial bulb.



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## ENCHYTRÆIDÆ

MESENCHYTRÆUS OBSCURUS. 1, 2.

MESENCHYTRÆUS EASTWOODI. 3.





## PLATE VII.

### *Mesenchytræus grandis* sp. nov.

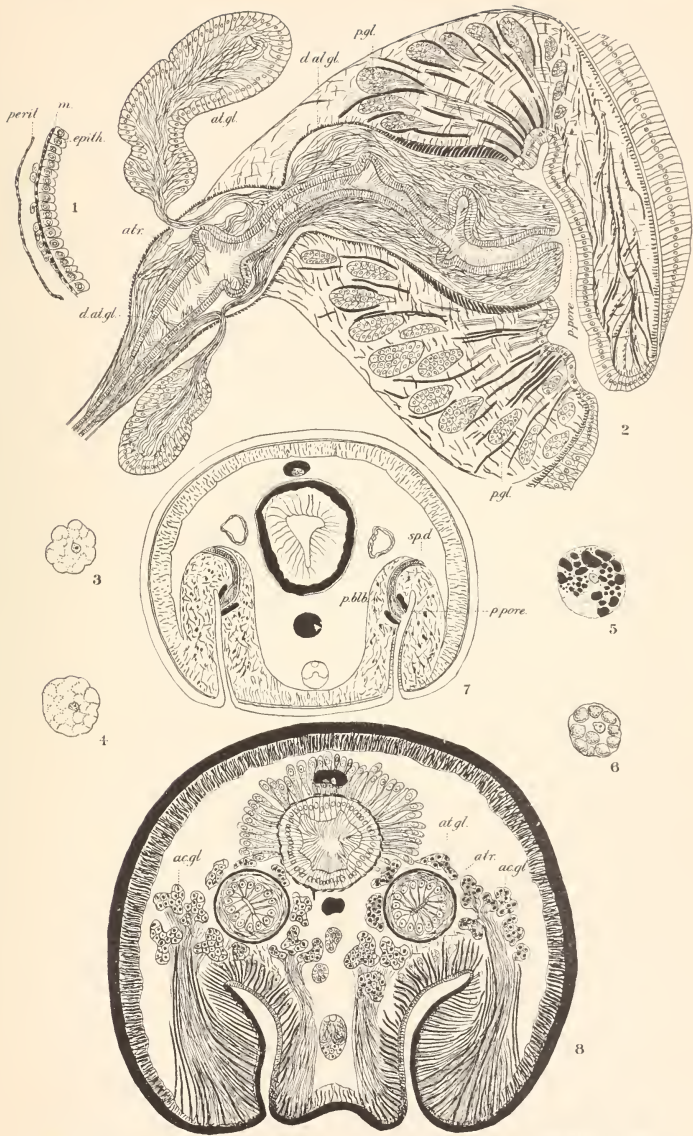
- FIG. 1. Section through the sperm-sac. *perit.*, peritoneum; *m.*, muscular layer; *ep.*, epithelium.
2. Section through the lower part of the sperm-duct and the penial bulb. *at.gl.*, prostates opening into the atrium (the ducts of the atrial glands are seen to pass down into the lower part of the sperm-duct); *d.at.gl.*, ducts of the prostates; *pb.*, penial bulb; *p.gl.*, penial glands (all are inside the bulb).
- 3, 4. Common lymphocytes.
5. Eosinophil lymphocyte.
6. Cyanophil lymphocyte.

### *Mesenchytræus kincaidi* sp. nov.

7. Section through the body, somite XII, passing through male-pores. There is only a small penial chamber inside the bulb, but no atrium in the same sense as in some other species of this genus. There are no penial glands inside the bulb, nor are there any atrial glands opening into the sperm-ducts.

### *Mesenchytræus solifugus* Emery.

8. Section through the penial pores and bulbs. *atr.*, atrium of the sperm-ducts; *ac.gl.*, accessory glands opening at the apex of the penial papillæ; these glands do not enter the penial bulb. The black part of this figure represents the body-wall strongly charged with pigment granules.



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ENCHYTRÆIDÆ

- MESENCHYTRÆUS GRANDIS. 1. 2. 3. 4. 5. 6.  
MESENCHYTRÆUS KINCAID. 7.  
MESENCHYTRÆUS SOLIFUGUS. 8.







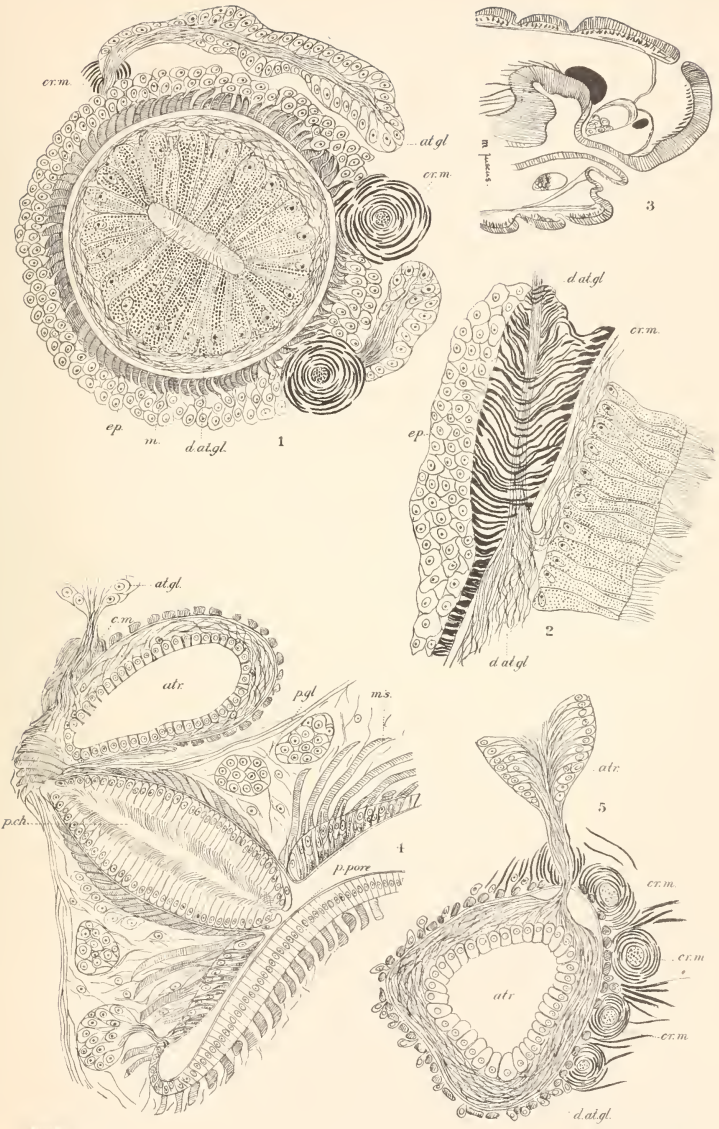
## PLATE VIII.

### *Mesenchytræus solifugus* Emery.

- FIG. 1. Cross-section of the atrium, showing the entrance of three of the atrial glands. *at.gl.*, atrial glands; *cr.m.*, circular muscles surrounding the ducts of the atrial glands at their entrance into the atrium; *d.at.gl.*, ducts of the atrial glands continuing into the atrium; *ep.*, a thick epithelial layer of cells surrounding the muscular part of the atrium. The inner large cells are strongly charged with eosinophilous granules. Similar granules are found in the atrial glands in large quantities.
2. A detail of the point of entrance of a prostate in the atrium; longitudinal section.

### *Mesenchytræus fuscus* sp. nov.

3. Anterior somites.
4. Section through the male-pore. *atr.*, atrium; *at.gl.*, atrial gland; *spd.*, sperm-duct; *p.gl.*, penial glands inside the bulb; *m.*, muscles separating the penial glands; *c.m.*, circular muscles surrounding the ducts of the atrial glands.
5. Cross-section of the atrium showing the entrance of one of the atrial glands and circular muscles surrounding the ducts of four other atrial glands. *atr.*, atrium; *at.gl.*, atrial gland; *spd.*, sperm-duct; *p.gl.*, penial glands inside the bulb; *m.*, muscles separating the penial glands; *d.at.gl.*, ducts of the prostate cells. The fine ducts, or prolongations of the unicellular atrial glands, are seen as a mass surrounding the clear glandular epithelium inside the atrium.



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ENCHYTRÆIDÆ

MESENCHYTRÆUS SCALIFUGUS. 1, 2, 3  
MESENCHYTRÆUS FUSCUS. 3, 4, 5





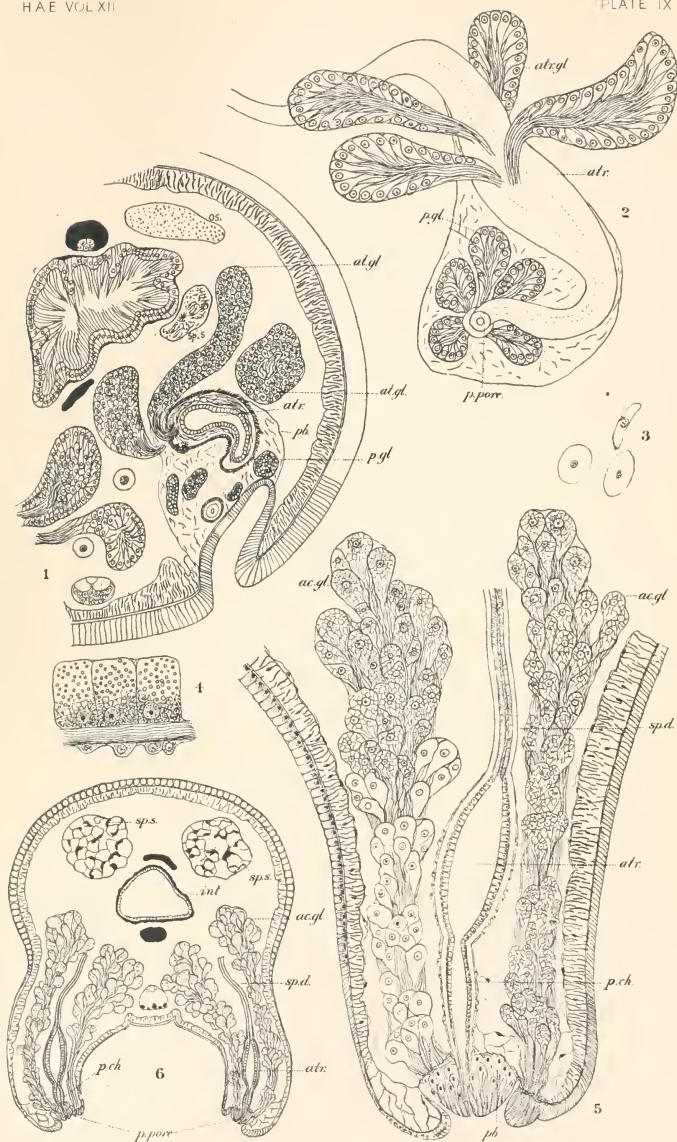
## PLATE IX.

### *Mesenchytræus penicillus* sp. nov.

- FIG. 1. Section through the somite containing the male-pore. *pb.*, penial bulb, sagittal section; *at.gl.*, prostates opening through the bulb into the atrium; *atr.*, atrium; *p.gl.*, penial glands inside the bulb; *sp.s.*, sperm-sacs; *os.*, ovisacs.
2. The lower part of the sperm-duct with the four atrial glands opening into the atrium. Letters indicate the same as in fig. 1.

### *Mesenchytræus pedatus* sp. nov.

3. Lymphocytes. These are of very large size and in this respect different from most other species of the genus *Mesenchytræus*.
4. Section through the atrium, showing the inner epithelium, the muscles, and the outer epithelium. There are no prostates in the species.
5. Longitudinal section through somite XII passing through male-pores. *atr.*, atrium; *l.ch.*, lower chamber of the sperm-duct, a secondary atrium; *p.blb.*, penial bulb containing unicellular glands; *ac.gl.*, accessory glands opening at the apex of the penial papilla; *sp.d.*, sperm-ducts; *sp.s.*, sperm-sacs; *int.*, intestine (the dark lines are blood vessels).
6. Cross-section through male-pores more highly magnified than in the last figure.



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## ENCHYTRÆIDÆ

MESENCHYTRÆUS PENICILLUS, 1, 2.  
 MESENCHYTRÆUS PEDATUS, 3, 4, 5, 6.



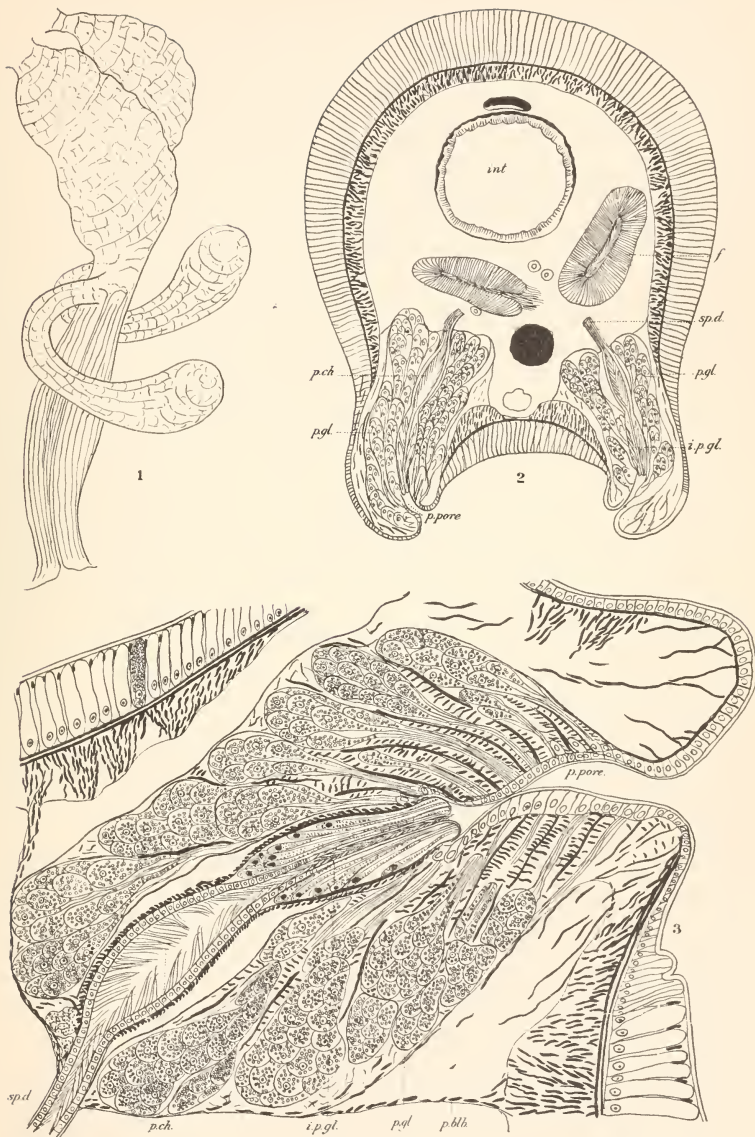




## PLATE X.

### *Mesenchytræus beringensis* sp. nov.

- FIG. 1. Spermatheca. Side view. One spermatheca is seen entire. Of the other only the junction with the intestine is shown.
2. Transverse section of the body in somite XII, passing through the sperm-ducts and the male-pores. The penial bulb is seen to contain large penial glands, while the absence of accessory and atrial glands is prominently characteristic. *p.ch.*, penial chamber; *f.*, funnels; *p.gl.*, penial glands; *sp.d.*, sperm-ducts.
3. Section passing through the male-pore and papilla; from a transverse section of the body. *p.b.*, penial bulb; *p.ch.*, penial chamber or lower part of sperm-duct; *p.gl.*, penial glands, opening around the pores and entirely confined inside the penial bulb; *atr.*, atrium of the sperm-duct. The penial chamber is enclosed in a sheath of circular muscles. A few intra-penial glands open around the pore.



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## ENCHYTRÆIDÆ

MUSENCHYTRÆUS BERINGENSIS, 1, 2, 3





## PLATE XI.

### *Mesenchytræus orca* sp. nov.

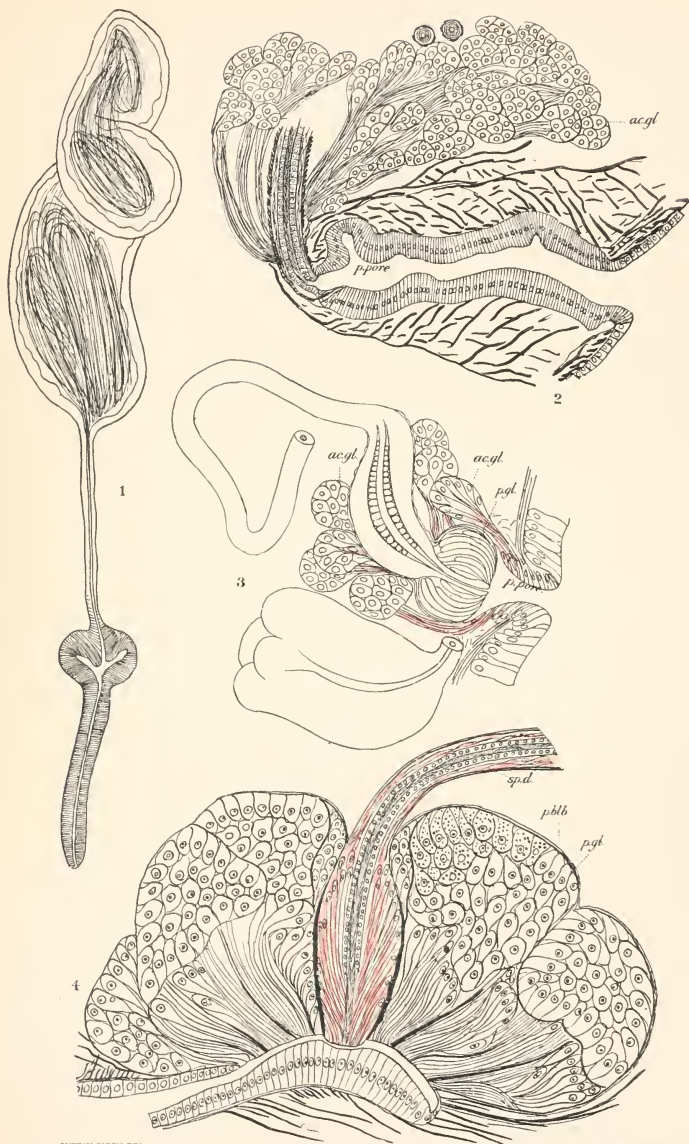
- FIG. 1. Spermatheca. One of average size; in other specimens the ampulla was considerably larger in proportion to the duct.
2. Section passing through the penial pore. The penial bulb is seen to be unusually small, consisting only of muscle fibers and connective tissue. There are only atrial glands opening into the atrium at or not far from the pore. The atrium is about twice as thick as the sperm-duct. Two sections of the latter are seen in the figure. Only the basal part of the atrium is engaged in the muscles of the penial bulb.

### *Mesenchytræus fontinalis* sp. nov.

3. Part of the spermiducal apparatus; only part of the duct is shown. There are no prostates, only accessory glands opening at the apex of the penial papilla. The funnel is shown to the left. *gl.c.*, glandular cells composing the bulb; *atr.*, atrium; *ac.gl.*, accessory glands opening at apex outside of the bulb.

### *Mesenchytræus asiaticus* sp. nov.

4. Section through the penial bulb and part of the atrium. The atrial glands and their entrance into the atrium are not shown in the figure, but the ducts of the glands are indicated.



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## ENCHYTRÆIDÆ

MESENCHYTRÆUS ORCÆ. 1, 2

MESENCHYTRÆUS FONTINALIS. 3.

MESENCHYTRÆUS ASIATICUS. 4







## PLATE XII.

### *Bryodrilus udei* sp. nov.

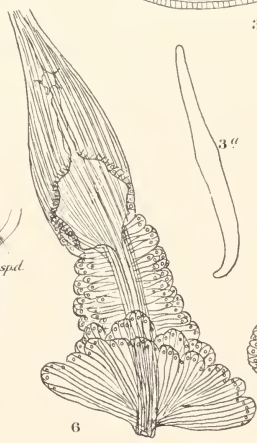
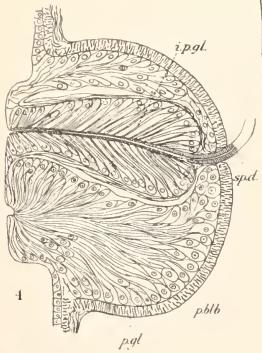
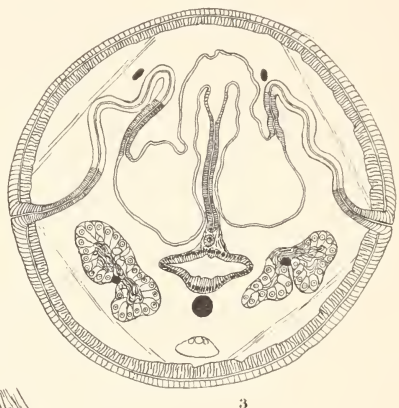
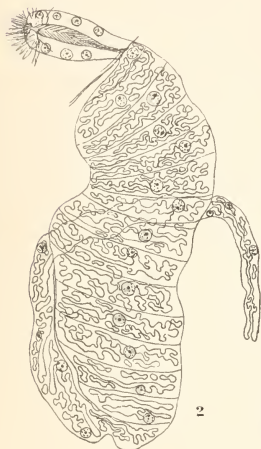
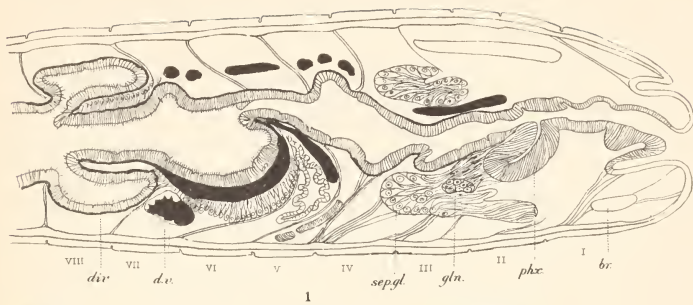
- FIG. 1. Section through the anterior somites. *br.*, brain; *phx.*, pharynx; *gln.*, ganglion enclosed in the anterior septal gland; *sep.gl.*, anterior septal gland; *dv.*, dorsal vessel; *div.*, diverticle of the intestine (there are four of these diverticles, only two appearing in the section).
2. One of the nephridia. The ducts are much ramified.
3. Section through somite v, showing the spermathecae and their junction with the intestine.
- 3a. A seta.
4. Section through the penial bulb. The lower part of the sperm-duct is furnished with small glands opening in the duct. Another set of glands open on the exterior of the bulb.

### *Lumbricillus merriami* sp. nov.

5. Spermatheca.

### *Lumbricillus merriami elongatus* var. nov.

6. Spermatheca.



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ENCHYTRÆIDÆ

PHRYNORILUS UEL. 1, 2, 3, 4.  
LUMBRICILLUS MERRIANI. 5

LUMBRICILLUS MERRIANI VAR. ELONGATUS. 6





## PLATE XIII.

### *Lumbricillus franciscanus* sp. nov.

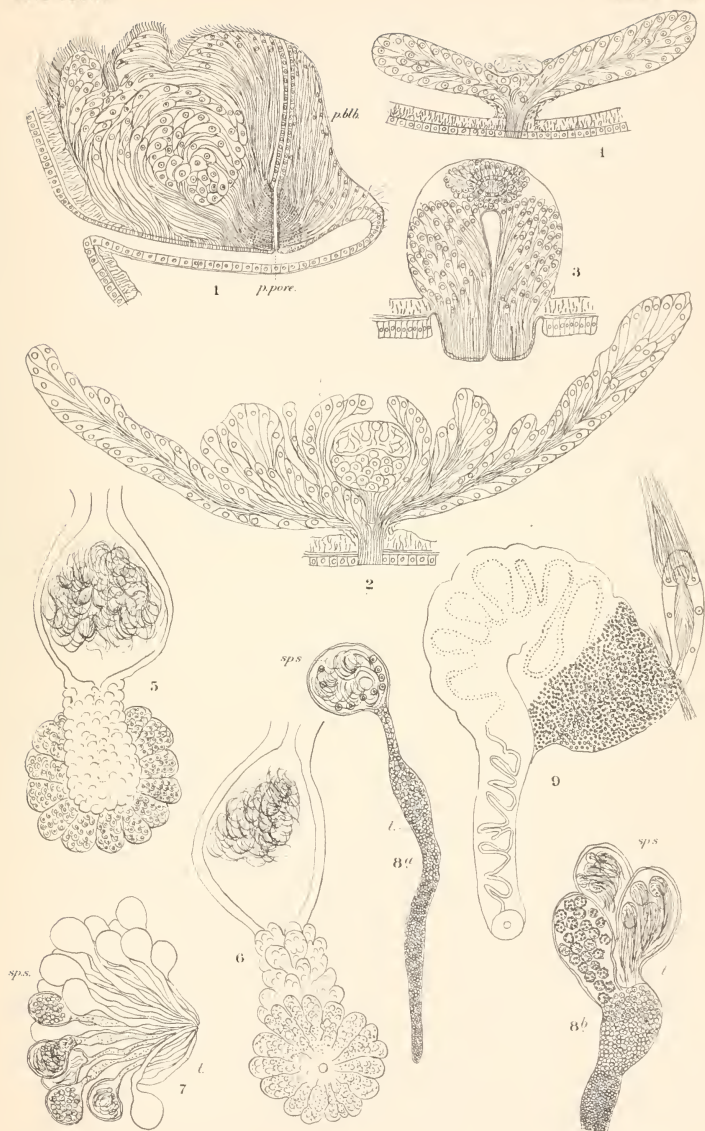
- FIG. 1. Section through the penial bulb. There are two sets of glands, one set opening into the sperm-ducts, the other on the surface of the bulb.
2. Section of one of the ventral glands.

### *Lumbricillus santæclaræ* sp. nov.

3. Section through penial bulb. At the top is seen the sperm-duct in section; surrounding the lower part of the duct are a set of unicellular glands.
4. Section through one of the ventral glands.

### *Lumbricillus ritteri* sp. nov.

5. Spermatheca. There are two sets of glands, one set around the base, and another along the duct. The apical part connects with the intestine.
6. Another spermatheca.
7. One of the testes.
- 8, *a, b*. Two lobes of the testis. The apical globular sacs are the sperm-sacs.
9. Nephridium. The neck of the central part is strongly glandular.



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## ENCHYTRÆIDÆ

LUMBRICILLUS FRANCISCANUS. 1, 2.

LUMBRICILLUS SANTEOLARÆ. 3, 4.

LUMBRICILLUS RITTERI. 5, 6, 7, 8, 9.







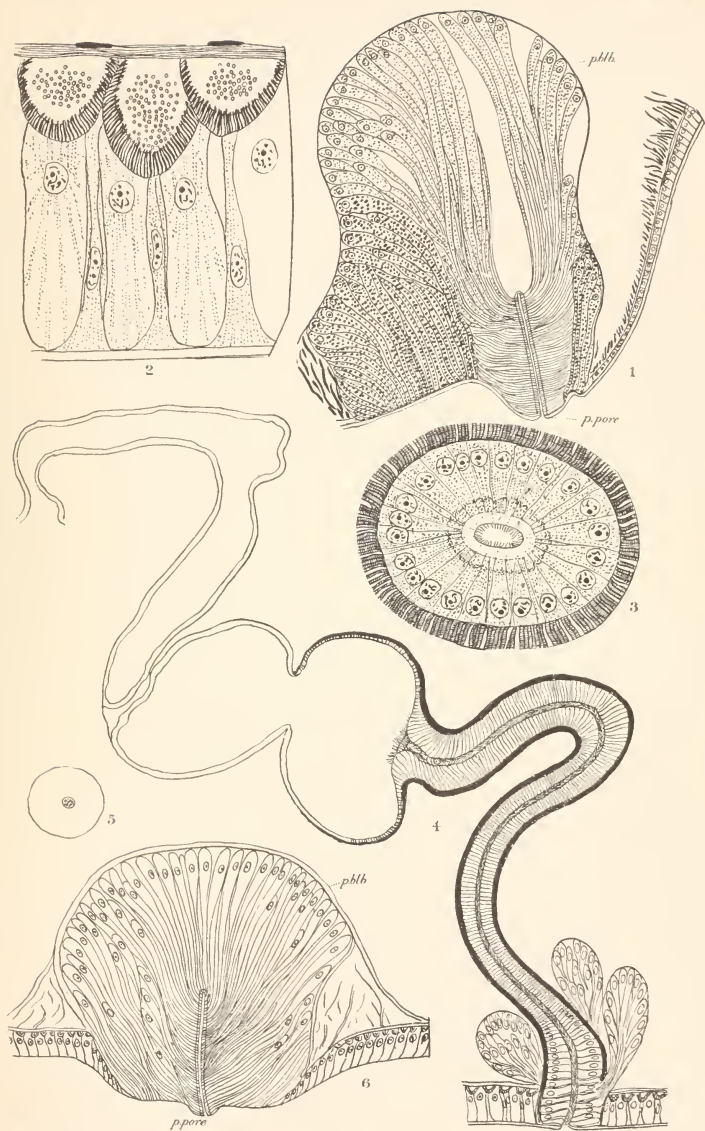
## PLATE XIV.

### *Marionina americana* sp. nov.

- FIG. 1. Penial bulb. The section passes rather obliquely through one side, and accordingly does not give a correct idea of the exterior shape of the bulb. The heavy glandular cells probably open onto the exterior in the same manner as in *Marionina alaskæ*.

### *Marionina alaskæ* sp. nov.

2. Longitudinal section of the body-wall. There are two kinds of cells in the epithelium, the narrower ones being touch-cells. The circular muscular layer is constructed on the nematode plan.
3. Section of spermatheca taken near the junction of the duct and the ampulla. The cells of the lumen are ciliated. They show a clear zone just back of the cilia, but owing to improper fixation more details cannot be given. The outer dark zone represents the longitudinal muscles.
4. Spermatheca. The figure is constructed from sections, and is accordingly only approximately correct as regards the relative size of the parts. The duct is covered with a strong layer of longitudinal muscles.
5. Lymphocyte.
6. The penial bulb in longitudinal section. There are two kinds of cells composing the glandular structure, one kind opening in the sperm-duct, the other around the pore.



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ENCHYTRÆIDÆ

MARIONIA AMERICANA. 1

MARIONIA ALASKÆ. 2, 3, 4, 5, 6





## PLATE XV.

### *Henlea californica* sp. nov.

- FIG. 1. Penial bulb. The narrower glands open close to the sperm-duct, while the wider and generally larger glands open along the base of the papilla outside of the sperm-duct. The relative difference of structure in the two sets of glands is diagrammatic. The narrower glands possess by far the finest granulation.

### *Henlea ehrhorni* sp. nov.

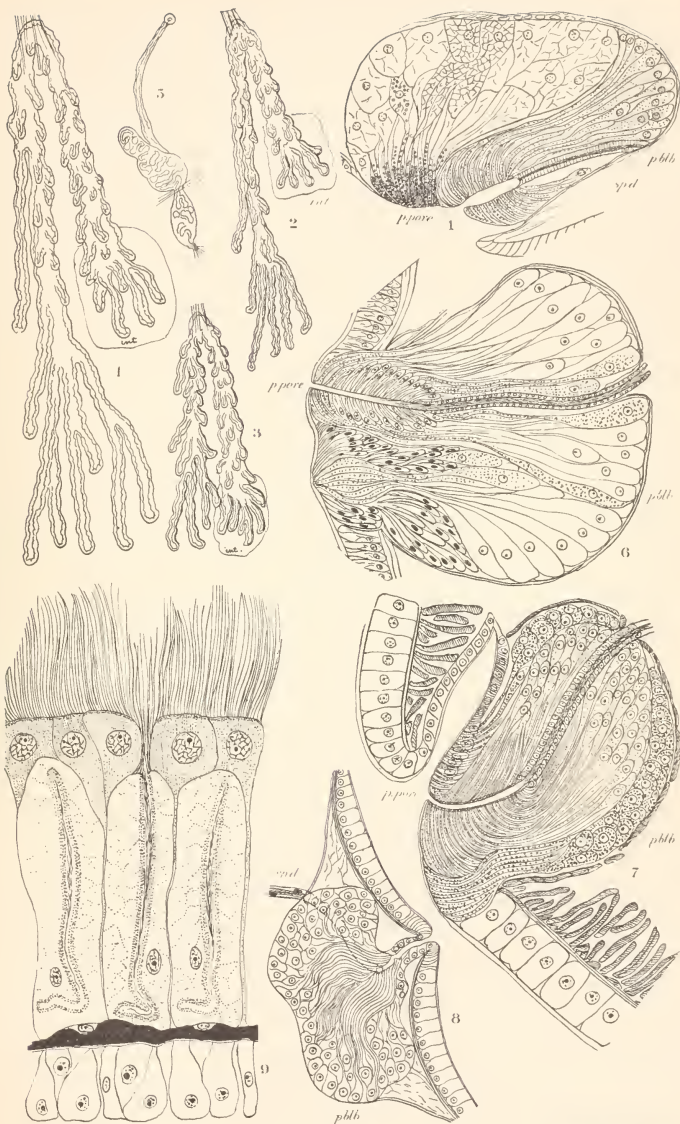
2. One of the salivary glands, dissected.
3. One of the salivary glands, dissected. The salivary glands in the specimen that was sectioned are typical, and not folded on themselves as in the dissected specimen.
4. One of the salivary glands, dissected.
5. A nephridium.
6. Penial papilla and bulb. There are four sets of glands, two sets opening into the sperm-duct, and two sets opening in or around a small pore anterior to the spermiducal pore.

### *Henlea guatemalæ* sp. nov.

7. Penial bulb, showing the arrangement of the different glandular cells.

### *Fridericia californica* sp. nov.

8. Section through the penial bulb. There is only one kind of unicellular glands. *spd.*, sperm-duct; *p.bb.*, penial bulb.
9. Chylus cells from the intestine, showing the interior chylus duct.



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# ENCHYTRÆIDÆ

*ENCHYTRÆUS* *AMERICANUS* (1)  
*ENCHYTRÆUS* *AMERICANUS* (2) (3) (4) (5)  
*ENCHYTRÆUS* *AMERICANUS* (6)  
*ENCHYTRÆUS* *AMERICANUS* (7)  
*ENCHYTRÆUS* *AMERICANUS* (8) (9)







## PLATE XVI.

### *Fridericia sonora* sp. nov.

- FIG. 1. Penial bulb and sperm-duct.
2. Section of the intestine in one of the somites posterior to clitellum, showing three chylus cells separated by blood vessels. They are lined by an inner ciliated epithelium. On the opposite side is a row of muscular strands covered by chloragogen cells.
  3. A chylus cell, showing interior canal and outer layer of ciliated epithelium. The blood is represented as black. Diagrammatic.

### *Fridericia santarosæ* sp. nov.

4. Penial bulb, in a transverse section of the body. The bulb contains a row of unicellular glands. *p.blb.*, penial bulb; *sp.d.*, sperm-duct; *gl.c.*, unicellular glands inside of the bulb, which constitute the main part of the bulb.
5. Chylus cells from the intestine.

### *Fridericia johnsoni* sp. nov.

6. A chylus cell from somite XII; surrounded by two epithelial cells. *ep.*, epithelial cells; *chy.*, chylus cells; *bl.*, blood vessel; *chlor.*, chloragogen cells.







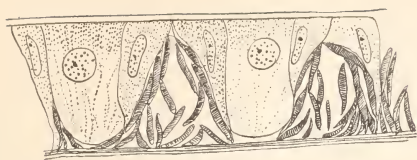
## PLATE XVII.

### *Fridericia fuchsi* sp. nov.

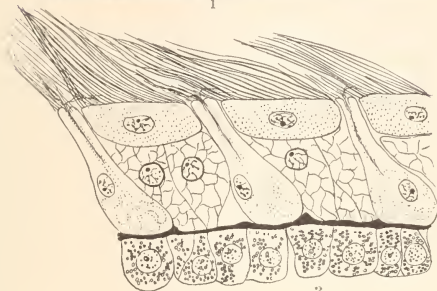
- FIG. 1. Longitudinal section of the body-wall, showing the deltoid arrangement of the circular muscular layer. The striated cytoplasm of the large epithelial cells is only indicated.
2. Section through the intestine, showing chylus cells and flat and long epithelial cells. Also interstitial cells with large round nuclei.
  3. A chylus cell and epithelial cells, from the intestine, more highly magnified than in the last figure.

### *Fridericia macgregori* sp. nov.

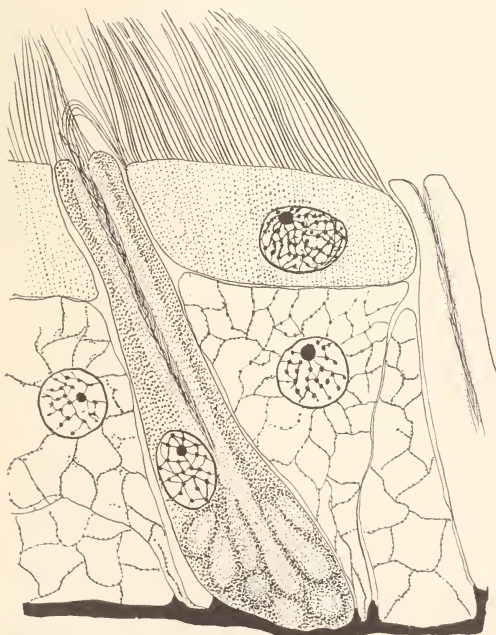
4. Set of chylus cells from the intestine.
5. One of the chylus cells more magnified.



1



2



3



5

## ENCHYTRÆIDÆ

1891-1892

1891-1892







PLATE XVIII.

*Lumbricillus annulatus* sp. nov.

FIG. 1. Section through the penial bulb.

*Enchytræus kincaidi* sp. nov.

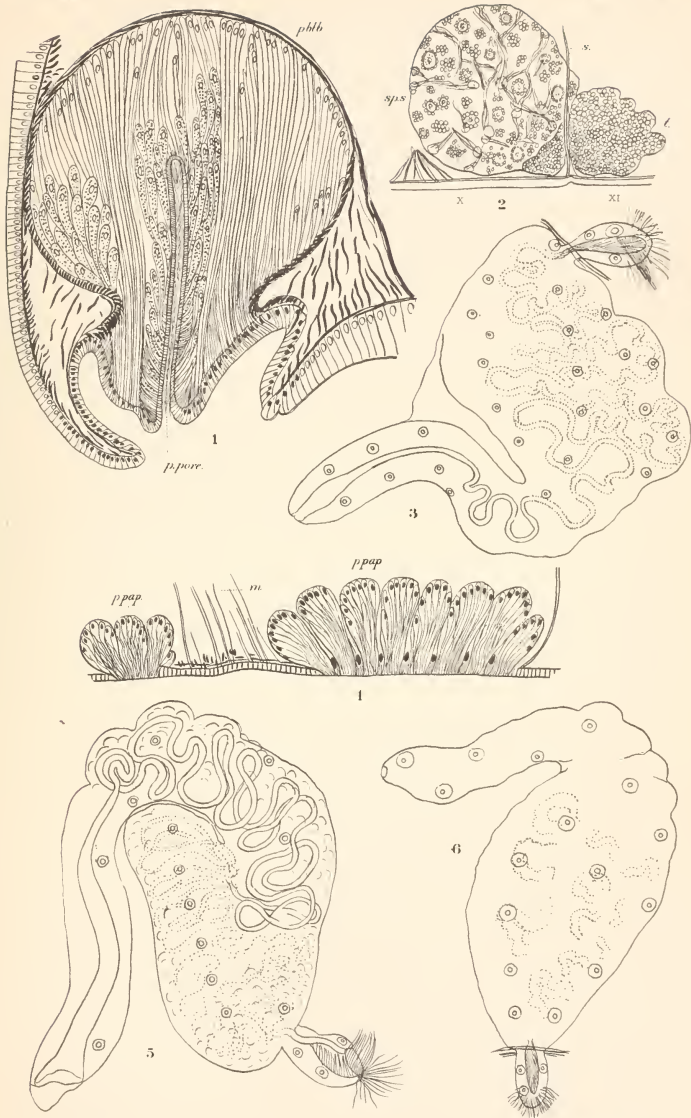
2. Testis and sperm-sac, the latter projecting into somite x.
3. Nephridium. It is composed of at least 30 cells.
4. Sexual bulbs with their papillæ, from longitudinal section of the body.  
The smaller complex is the anterior one.

*Enchytræus metlakatlensis* sp. nov.

5. Nephridium.

*Enchytræus saxicola* sp. nov.

6. Nephridium.



CONTINUED FROM

LUMBRICUS VIRGATUS

## ENCHYTRÆIDÆ

- LUMBRICULUS ANNULATUS, 1.  
 ENCHYTRÆUS VIRGATUS, 2, 3, 4.  
 ENCHYTRÆUS METAHATTIENSIS, 5.  
 ENCHYTRÆUS FAXISOLA, 6.





## PLATE XIX.

### *Enchytræus metlakatlensis* sp. nov.

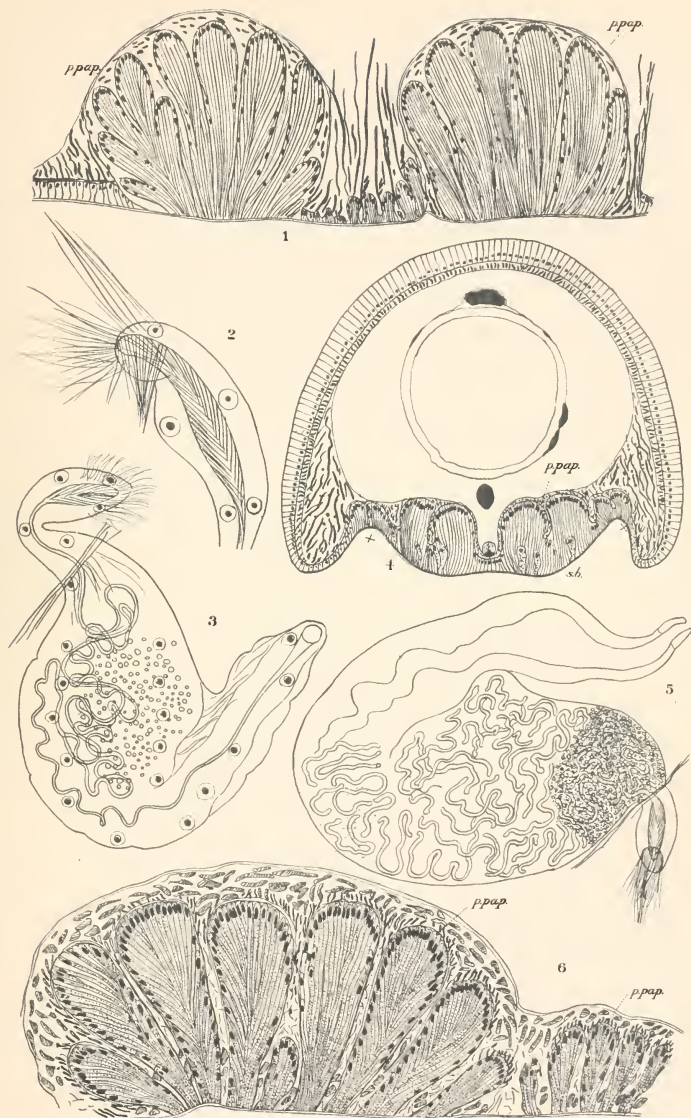
- FIG. 1. Longitudinal section of penial glands and papillæ. The sperm-ducts open between the two glandular accumulations.

### *Enchytræus modestus* sp. nov.

2. Nephrostome of a nephridium, higher magnification than fig. 3.  
3. Nephridium.

### *Enchytræus alaskæ* sp. nov.

4. Cross-section of body just behind the male-pores, showing the sexual papillæ on both sides of the ventral ganglion. In sections more forward the male-pores would lie in line with the points marked  $\times$ . The dorsal vessel although rising in  $\pi v$  has not yet separated itself from the intestine.  
5. Nephridium. The anterior part of the main body is strongly granular.  
6. Longitudinal section of the ventral part of the body wall passing through the penial papillæ. There are eight or nine bunches of glands opening on the surface of the body. The penial papilla lies to the right of this papilla.



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## ENCHYTRÆIDÆ

ENCHYTRÆUS METLAHKATLENSIS, 1.

ENCHYTRÆUS MODESTUS, 2. 3.

ENCHYTRÆUS ALASKÆ, 4. 5. 6.







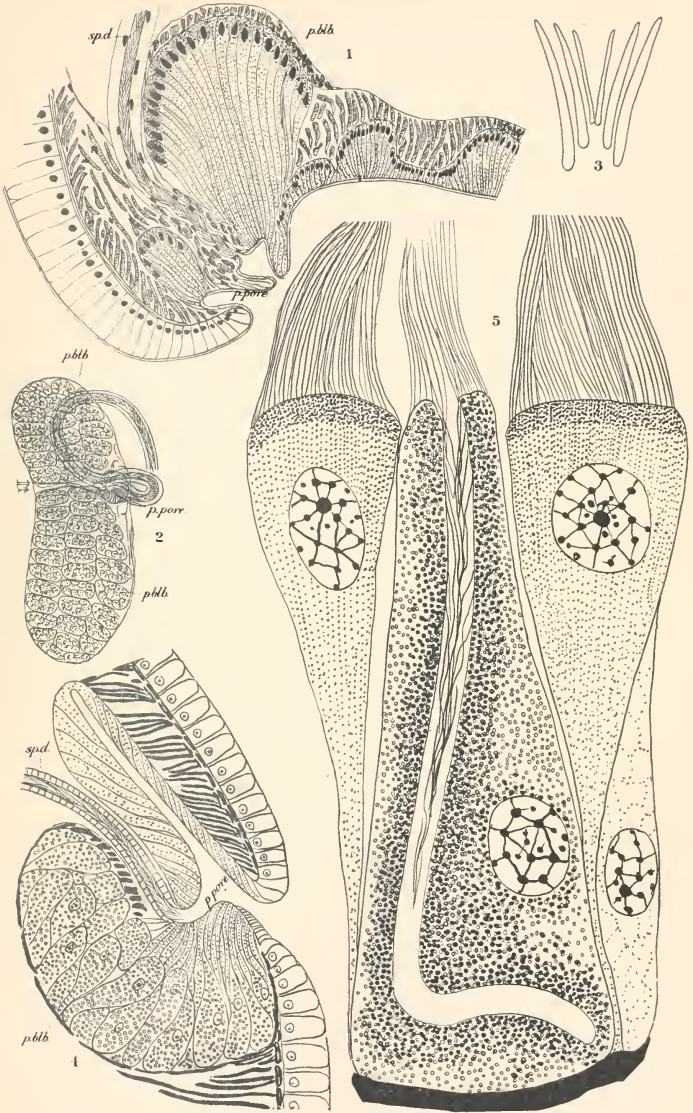
## PLATE XX.

### *Enchytræus alaskæ* sp. nov.

- FIG. 1. Transverse section of the body-wall passing through the male-pore and the penial papillæ. As will be seen, there are no glands opening into the sperm-duct.
2. Spermiducal pore, sperm-duct, and two penial papillæ.

### *Fridericia harrimani* sp. nov.

3. Setæ fascicle from ventral side.
4. Section of penial bulb, from a transverse section of the body. Showing that the sperm-duct enters the bulb on one side and nearer the base than in most other varieties. There are two kinds of cells, some of which open into the lower part of the sperm-duct, while others open on the free outer surface of the bulb.
5. Section of the intestine in somite XIII, showing the chylus cell surrounded by two epithelial cells and an interstitial cell. The chylus canal is lined by a distinct membrane, the upper part of which is ciliated. At the base of the chylus cell is a blood sinus.



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ENCHYTRÆIDÆ

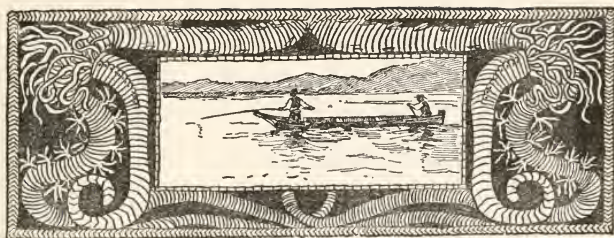
ENCHYTRÆUS ALASKÆ, 1, 2.

FRIDERICIA HARRIMANI, 3, 4, 5.



TUBICOLOUS ANNELIDS OF TRIBES  
SABELLIDES AND SERPULIDES  
FROM THE PACIFIC OCEAN





# TUBICOLOUS ANNELIDS OF THE TRIBES SABELLIDES AND SERPULIDES FROM THE PACIFIC OCEAN

BY KATHARINE JEANNETTE BUSH, PH.D.

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Species previously recorded from the Pacific . . . . .	172
New genera . . . . .	178
Species new to the region . . . . .	179
Systematic discussion . . . . .	183
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## INTRODUCTION

PRACTICALLY nothing was known of the annelids of the North Pacific coast before Johnson's valuable reports of 1897 and 1901 — the first entitled 'A Preliminary Account of the Marine Annelids of the Pacific Coast,' the other 'The Polychæta of the Puget Sound Region.' This is especially true of Alaska, a few species only having been recorded north of Vancouver Island, British Columbia; therefore the collections made by Dr. William E. Ritter, of the University of California, and Dr. Wesley R. Coe, of Yale University, as members of the Harriman Alaska Expedition of 1899, are of great interest.

Of the 35 species from Alaska described as new to the North Pacific fauna (p. 179), only 4 — *Spirorbis spirillum* (Linné) and variety *lucidus* Montagu, *Spirorbis mörchi* Levinsen, *Spirorbis quadrangularis* Stimpson, and *Spirorbis violaceus* Levinsen — appear to be circumpolar; of these but one — *Spirorbis spirillum* (Linné), with its variety *lucidus* Montagu — extends southward along the California coast. *Schizobranchia insignis* sp. nov. appears at Vancouver Island, where also *Eudistylia tenella* sp. nov. is found.

Of the remaining species, 9, as far as known, occur only on the coast of California (at Pacific Grove), 1 on the coast of Mexico, and 1 on the coast of Honolulu.

The 148 species given in the list (p. 172) as previously recorded from the Pacific were about equally distributed north and south of the equator, there being but 9 more above than below it before Moore (1904) added 13 from the coast of Japan; but in the North Pacific those forming the more or less flexible tubes are numerous, while in the South Pacific those building firm calcareous ones predominate. Only 8, however, have thus far been found from Puget Sound northward along the coast of Alaska.

As will be seen by the following list, most of the forms, the larger number of which are of unusual size, are representatives of well-known genera.

Among the Polynoidæ and closely related families, as well as among the Sabellidæ and Serpulidæ, are to be found most of the unique forms, although there are two very interesting sexual individuals, one similar to that figured by Örsted (1843) as *Polybostrichus*, now placed with the Syllidæ, and another, of unknown relationship, which has the ventral surface covered by large clusters of eggs attached to each segment in pairs.

LIST OF FAMILIES AND KNOWN GENERA REPRESENTED  
IN THE COLLECTION.

APHRODITACÆ	<i>Harmothoe</i> , 8 sp.
<i>Iphione</i> ?	<i>Lænilla</i> ?
POLYNOIDÆ	<i>Polynoc</i> , 2 sp.
<i>Lcpidonotus</i> , 3 sp.	<i>Lcpidametria</i> ?



SIGALIONIDÆ	EUPHROSYNIDÆ
<i>Phlœ</i>	<i>Spinther</i> ?
PHYLLODOCIDÆ	AMPHINOMIDÆ
<i>Phyllodoce</i> , 4 sp.	<i>Notopygus</i> ?
<i>Eulalia</i> , 2 sp.	SCALIBREGMIDÆ
<i>Etcone</i> , 4 sp.	<i>Eumenia</i>
NEPITHYDÆ	<i>Scalibregma</i>
<i>Nephthys</i> , 9 sp.	TELETHUSÆ
GLYCERIDÆ	<i>Arcnicola</i> , 2 sp.
<i>Glycera</i> , 4 sp.	CAPITELLIDÆ
STAUROCEPHALIDÆ	<i>Notomastus</i>
<i>Staurocephalus</i>	MALDANIDÆ
LUMBRINEREIDÆ	<i>Nicomache</i>
<i>Lumbrineris</i> , etc., 4 sp.	<i>Axiothella</i>
EUNICIDÆ	AMMOCHARIDÆ
<i>Leodice</i>	<i>Ammochares</i> , 2 sp.
LYCORIDÆ	AMPHICTENIDÆ
<i>Nereis</i> , 7 sp.	<i>Pectinaria</i> , 3 sp.
SYLLIDÆ	HERMELLIDÆ
<i>Autolytus</i> ( <i>Polybostrichus</i> )	<i>Sabellaria</i>
<i>Syllis</i>	TEREBELLIDÆ
<i>Gnathosyllis</i> , etc.	<i>Amphitrite</i> , 2 sp.
SPIONIDÆ	<i>Terebella</i>
<i>Scolecoplepis</i>	<i>Nicolca</i>
<i>Polydora</i>	<i>Polycirrus</i>
<i>Spio</i> , etc.	SABELLIDÆ
CHÆTOPTERIDÆ	<i>Sabella</i> , 4 sp.
<i>Chætopterus</i>	<i>Parasabella</i> , 2 sp.
CIRRATULIDÆ	<i>Aspeira</i>
<i>Cirratulus</i>	<i>Schizobranchia</i> , 5 sp.
ARICIDÆ	<i>Eudistylia</i> , 4 sp.
<i>Aricia</i>	<i>Chone</i>
OPHELIIDÆ	ERIOGRAPHIDIDÆ
<i>Ammotrypane</i>	<i>Myxicola</i> , 2 sp.
<i>Ophelia</i>	SERPULIDÆ
CHLORÆMIDÆ	<i>Serpula</i>
<i>Trophonia</i> , 3 sp.	<i>Crucigera</i> , 3 sp.
<i>Flabelligera</i> , 5 sp.	<i>Hyalopomatopsis</i>
<i>Brada</i> , 4 sp.	<i>Spirorbis</i> , 10 sp.

As an aid to students interested in the many much misunderstood forms found among the Sabellides and Serpulides, and also because so little is known of those from the Pacific, descriptions and figures of a few species collected in 1901 at Pacific

Grove, California, by Dr. Coe, are added, and also some facts regarding the few known species obtained farther south.

The *Spirorbis* group, recently found of so much interest (p. 252), has been thoroughly studied as a whole; the results are here given in as condensed a form as seems possible without interfering with a clear understanding of the many species.

The three following lists, although not properly a part of the introduction, are placed here for convenience.

SPECIES PREVIOUSLY RECORDED FROM THE PACIFIC  
ARRANGED WITH REFERENCE TO THEIR  
GEOGRAPHICAL DISTRIBUTION.

*North Pacific.*

**Bering Sea :**

1. *Pseudopotamilla reniformis* (Leuckart, 1849, as *Sabella*,<sup>1</sup> figures, + Malmgren 1867, as *Potamilla*, figures, + Marenzeller 1890). Also North Atlantic.
2. *Euchone analis* (Kröyer) Malmgren 1865, figures, + Marenzeller 1890. Also North Atlantic.

**Puget Sound Region :**

3. ?<sup>2</sup> — *vancouveri* (Kinberg 1866, as *Sabella*). See p. 197.
4. *Eudistylia polymorpha* (Johnson 1901, as *Bispira*, figures). South to Pacific Grove, California.
5. *Megachone aurantiaca* Johnson 1901, figures.
6. *Myxicola pacifica* Johnson 1901, figures.
7. *Serpula columbiana* Johnson 1901, figures. South to San Francisco, California.
8. *Crucigera zygophora* (Johnson 1901, as *Serpula*, figures).

**Central America to United States of Colombia :**

9. *Hydroides crucigera* (Mörch 1863, as *Eucarphus*, figures). Central America, 14 fms.
10. *Pomatostegus kröyeri* Mörch 1863, figures. Central America.

<sup>1</sup> When the generic name has been changed by subsequent writers, the original one is also given after the name of the author.

<sup>2</sup> An interrogation mark in the place of the generic name indicates that the description of the species is not sufficiently clear to determine its position.

11. *Spirobranchus incrassatus* (Kröyer) Mörch 1863, figures, + Ehlers 1887, figures.
12. *Spirorbis marioni* Caullery and Mesnil 1897, figures. Panama.
13. *Spirorbis langerhansi* Caullery and Mesnil 1897, figures. Panama.

#### Honolulu :

14. *Dasychone havaica* (Kinberg 1866, as *Sabella*).
15. *Demonax krusensterni* Kinberg 1866.
16. *Demonax cooki* Kinberg 1866.

#### Japan :

17. *Sabella fullo* Grube 1877.
18. *Sabella tricolor* Grube 1877.
19. *Sabella aulaconota* Marenzeller 1884, figures.
20. *Sabella japonica* Moore 1904, figures. 63-75 fms.
21. *Potamilla acuminata* Moore 1904, figures. 153 fms.
22. *Aspcira* sp. ? (Marenzeller 1884, as *Potamilla torcelli* Malmgren, figures).
23. *Pseudopotamilla suavis* (Grube 1877, as *Potamilla*).
24. *Pseudopotamilla myriops* (Marenzeller 1884, as *Potamilla*, figures).
25. *Paralaonome japonica* (Marenzeller 1884, as *Laonome*, figures).
26. *Laonome tridentata* Moore 1904, figures. 63-75 fms.
27. *Dasychone japonica* McIntosh 1885, figures, + Moore 1904. 50 fms.
28. *Demonax picta* (McIntosh 1885, as *Dasychone*, figures). 50 fms.
29. *Hypsicomus phæotænia* (Schmarda 1861, as *Sabella*, figures) Marenzeller 1884, figures. Also Ceylon.
30. *Hypsicomus lyra* Moore 1904, figures. 63-75 fms.
31. *Euchone alicaudata* Moore 1904, figures. 153 fms.
32. *Myxicola platychæta* Marenzeller 1884, figures.
33. *Protula geniculata* Moore 1904, figures. 63-75 fms.
34. *Apomatus enosimæ* Marenzeller 1884, figures.
35. ? — *ctenophora* (Moore 1904, as *Vermilia*, figures).
36. ? — *pluriannulata* (Moore 1904, as *Vermilia*, figures). 45 fms.
37. *Hydroides multispinosa* Marenzeller 1884, figures, + McIntosh 1885, figures, *non* Fischli 1900, figures. 8-50 fms.
38. *Eupomatus fusicola* Mörch 1863.
39. *Eupomatus exaltatus* Marenzeller 1884, figures.

40. ? — *diplochone* (Grube 1877, as *Hydroides*).<sup>1</sup>
41. *Serpula jukesii* Baird 1865 (?), figures, + Grube<sup>2</sup> 1877.
42. *Serpula granulosa* Marenzeller 1884, figures.
43. *Omphalopomopsis langerhansii* (Marenzeller 1884, as *Omphalopoma*, figures) Saint-Joseph 1894, as type.
44. *Pomatostegus latiscapus* Marenzeller 1884, figures, + Moore 1904.
45. *Pomatoceros helicoides* Marenzeller 1884, figures.
46. *Pomatoceros aurilubis* Moore 1904, figures. 45 fms.
47. *Spirorbis argutus* Bush 1904, figures. 34 fms.
48. *Spirorbis bellulus* Bush 1904, figures. 63-75 fms.
49. *Spirorbis dorsatus* Bush 1904. 63-75 fms.
50. *Spirorbis foraminosus* Bush<sup>3</sup> 1904, figures. 34 fms.

#### Hong Kong :

51. *Dasychone orientalis* McIntosh 1885, figures. 10 fms.

#### Philippine Islands :

52. *Sabella acrophthalmos* Grube 1878.
53. *Dasychone cingulata* Grube 1878, figures.
54. *Dasychone boholensis* Grube 1878.
55. *Dasychone serratibranchis* Grube 1878, figures.
56. *Eurato pyrrhogaster* (Grube 1878, as *Sabella*, figures) Saint-Joseph 1894, first species as type.
57. *Eurato porifera* (Grube 1878, as *Sabella*, figures) Saint-Joseph 1894.
58. *Eurato manicata* (Grube 1878, as *Sabella*, figures) Saint-Joseph 1894.
59. *Eurato notata* (Grube 1878, as *Sabella*) Saint-Joseph 1894.
60. ? — *spectabilis* (Grube 1878, as *Sabella*, figures, + Marenzeller 1884, as *Laonome*, figures, + Saint-Joseph 1894, as *Sabellastarte*).
61. ? — *zebusensis* (McIntosh 1885, as *Sabella*, figures). 95 fms.
62. ? — *tenuitorquus* (Grube 1878, as *Potamilla*, figures).

<sup>1</sup>The operculum is described as two complete funnels bordered with deep serrations, one above the other and may prove to be a *Eupomatus*.

<sup>2</sup>Grube's description of this species does not appear to agree very closely with that of Baird.

<sup>3</sup>The description and figures of these four species (47-50) of *Spirorbis* were prepared for insertion in Mr. J. Percy Moore's report on the *Sabellas* and *Serpulas* collected off the coast of Japan by the U. S. steamer *Albatross* in 1900. This is now passing through the press, with every probability of early publication. Mr. Moore has very kindly furnished a list of species included in this paper.

63. *Pseudopotamilla polyophthalmos* (Grube 1878, as *Potamilla*, figures).
64. *Pseudopotamilla oligophthalmos* (Grube 1878, as *Potamilla*, figures).
65. *Myxicola ommatophora* Grube 1878, figures.
66. *Eucarphus cumingii* Mörch 1863.
67. *Schizocraspedon furcifera* (Grube 1878, as *Hydroides*, figures). See p. 225.
68. *Glossopsis minax* (Grube 1878, as *Hydroides*, figures). See p. 225.
69. ? — *philippensis* (McIntosh 1885, as *Serpula*, figures). 1050 fms.
70. *Dasynema chrysogyrus* (Grube 1878, as *Serpula*, figures) Saint-Joseph 1894, as type.
71. *Pomatostegus actinocerus* Mörch 1863, figures, + Grube 1878, as *Serpula*.
72. *Spirobranchus semperi* Mörch 1863.
73. *Spirobranchus tricornigerus* (Grube 1878, as *Serpula*, figures).
74. *Spirobranchus quadricornis* (Grube 1878, as *Serpula*, figures).
75. *Pomatoceros bucephalus* Mörch 1863.
76. *Placostegus porosus* (Daudin 1800, as *Vermetus*, figure) Mörch 1863.
77. *Placostegus ornatus* (Sowerby, as *Serpula*, figure) Mörch 1863.
78. *Omphalopoma umbilicata* (Mörch 1863, as *Placostegus*).
79. *Galeolaria hystrix* Mörch 1863.
80. *Galeolaria tetracera* (Schmarda 1861, as *Pomatoceros*, figure).
81. *Ditrypa gracillima* Grube 1878.

#### Ternate Island :

82. *Dasychonopsis maculata* (Fischli 1900, as *Dasychone*, figures).
83. *Protulopsis nigra-nucha* Fischli 1900, figures.
84. *Eucarphus ternatensis* (Fischli 1900, as *Hydroides multispinosa* Marenzeller, variety, figures).

#### South Pacific.

#### Peru and Chili :

85. ? — *tilosaulus* (Schmarda 1861, as *Sabella*, figures, + Kinberg 1866, as *Demonax*, + Ehlers 1901, as *Sabella*).
86. ? — *leucaspis* (Kinberg 1866, as *Demonax*, + Ehlers 1901).

87. ? — *incertus* (Kinberg 1866, as *Demonax*, + Ehlers 1901).  
 88. *Zopyrus* ? sp. (McIntosh 1885, as *Vermilia*, figures). 1450 fms.  
 89. *Placostegus* sp. ? Ehlers 1900, + 1901.  
 90. *Spirorbis chilensis* Gray 1849, + Ehlers 1901.

**Straits of Magellan and vicinity :**

91. *Sabella* sp. Ehlers 1901. 8-50 fms.  
 92. *Sabella magelhænsis* Kinberg 1866, + Ehlers 1901.  
 93. *Paralaonome* ? *antarctica* (Kinberg 1866, as *Laonome*, + Ehlers 1897, 1900, 1901). 2-12 fms.  
 94. *Dasychonopsis curta* (Ehlers 1901, as *Dasychone*, figures). 20 fms.  
 95. *Fabricia alata* Ehlers 1897, figures, + 1901. 1-2 fms.  
 96. *Oria limbata* Ehlers 1897, figures, + 1901. 5 fms.  
 97. *Serpula narconensis* Baird<sup>1</sup> 1864, figures, variety *magellanica* McIntosh 1885, figures. 15-175 fms.  
 98. *Zopyrus loveni* Kinberg 1866, + Ehlers 1901.  
 99. *Metavermilia nigropilcata* (Ehlers 1900, + 1901, as *Vermilia*, figures).  
 100. *Spirorbis nordenskjöldi* Ehlers 1900, + 1901.  
 101. *Spirorbis perrieri* Caullery and Mesnil 1897, + Ehlers 1900, + 1901. 20 fms.  
 102. *Spirorbis lebruni* Caullery and Mesnil 1897, + Ehlers 1900, + 1901. 20-25 fms.  
 103. *Spirorbis levisenii* Caullery and Mesnil 1897, + Ehlers 1901.  
 104. *Spirorbis patagonicus* Caullery and Mesnil 1897, + Ehlers 1901.  
 105. *Spirorbis claparedi* Caullery and Mesnil 1897, + Ehlers 1901.  
 106. *Spirorbis aggregatus* Caullery and Mesnil 1897, + Ehlers 1901.

**Figi Islands and vicinity :**

107. *Sabella samoensis* Grube 1870.  
 108. *Dasychone cingulata* Grube 1870.

**Mid Ocean :**

109. ? — *ornatus*<sup>2</sup> (McIntosh 1885, as *Placostegus*, figures). 2375 to 3125 fms.

<sup>1</sup> Ehlers 1901 refers this species to *Serpula vermicularis* Linné 1767.

<sup>2</sup> This species is not a *Placostegus* as the uncini have but few coarse teeth similar to *Serpula*. The operculum is protected by a calcareous plate. It is not probable that this is identical with *P. ornatus* Sowerby from the Philippine Islands.

110. ? — *benthalianus* (McIntosh 1885, as *Placostegus*, figures). 3125 fms.  
 111. *Protoplacostegus mörchii* (McIntosh 1885, as *Placostegus*, figures). 2375 fms. See p. 226

## New Zealand :

112. ? — *ceratodaula* (Schmarda 1861, as *Sabella*, figures).  
 113. ? — *armata* (Quatrefages 1865, as *Sabella*, figures).  
 114. ? — *grandis* (Baird 1865, as *Sabella*).  
 115. *Apomatus elisabethæ* McIntosh 1885, figures.  
 116. *Galeolaria hystrix* Mörch 1863, figures.  
 117. *Galeolaria boltoni* (Baird 1865, as *Eupomatus*, figures).  
 118. *Eucarpus cumingii* Mörch 1863, variety *navalis* Mörch 1863.  
 119. *Sclerostyla zelandica* (Baird 1865, as *Serpula*, figures).  
 120. *Placostegus cariniferus* (Gray 1843) Baird 1865.  
 121. *Placostegus cæruleus* Schmarda 1861, figures, + Mörch 1863.  
 122. *Spirorbis zelandicus* Gray 1843, + Mörch 1863.

## Australia :

123. *Spirographis australiensis* Haswell 1884.  
 124. ? — *velata* (Haswell 1884, as *Sabella*, figures).  
 125. ? — *punctulata* (Haswell 1884, as *Sabella*, figures).  
 126. ? — *sulcata* (Ehlers 1897, as *Sabella*) (*Sabella fusca* McIntosh 1885, figures, non Grube). 2-10 fms.  
 127. *Filograna divaricata* Mörch 1863 (*Serpula filigrana* Lamarck 1818).  
 128. *Salmacina australis* Haswell 1884, figures.  
 129. *Galeolaria cæspitosa* Lamarck 1818, + Mörch 1863, figures, + Haswell 1884, as *Vermilia*.  
 130. *Galeolaria elongata* Lamarck 1818, + Mörch 1863.  
 131. *Galeolaria decumbens* Sowerby, figures, + Mörch 1863.  
 132. *Galeolaria rosea* (Quatrefages 1865, as *Vermilia*, figures, + Haswell 1884, figures).  
 133. *Galeolaria* ? *tetracera* (Schmarda 1861, as *Pomatoceros*, figures) Mörch 1863.  
 134. *Hydroides elegans* (Haswell 1884, as *Eupomatus*, figures).  
 135. *Serpula jukesii* Baird 1865, figures, + Haswell 1884.  
 136. *Serpula vasifera* Haswell 1884, figures.  
 137. *Zopyrus kampferi* Kinberg 1866.  
 138. *Pomatostegus strigiceps* Mörch 1863, as *Pomatoceros*, + McIntosh 1885, figures, + Haswell 1884, as *Vermilia*). 150 fms. Also New Zealand.

139. *Pomatostegus bowerbanki* Baird 1865, figures, + Haswell 1884.
140. *Spirobranchus rostratus* (Lamarck 1818, as *Vermilia*) Mörch 1863.
141. *Spirobranchus mörchi* (Quatrefages 1865, as *Cymospira*, + Haswell 1884).
142. *Spirobranchus brachyccra* (Baird 1865, as *Cymospira*, figures, + Haswell 1884).
143. *Pomatoceros elephus* Schmarda 1861, figures, + Haswell 1884, figures.
144. *Placostegus taniatus* (Lamarck 1818, as *Vermilia*) Mörch 1863.
145. *Ditrypa strangulata* Deshayes, figure, + Mörch 1863.
146. *Spirorbis tricostalis* Lamarck 1818, + Mörch 1863.
147. *Spirorbis lamellosus* Lamarck 1818, + Mörch 1863.
148. *Spirorbis incisus* Mörch 1863.

#### NEW GENERA.

The following genera, fifteen in number, are here proposed :

##### Paralaonome.

Type, *P. japonica* (Marenzeller 1884, as *Laonome*, figures).

##### Metalaonome.

Type, *M. mariæ* (Lo Bianco 1893, as *Bispira*, figures).

##### Dasychonopsis.

Type, *D. pallidus* sp. nov.

##### Parasabella.

Type, *P. media* sp. nov.

##### Aspeira.

Type, *A. modesta* sp. nov.

##### Pseudopotamilla.

Type, *P. reniformis* (Leuckart 1849, Malmgren 1867, as *Potamilla*, figures).

##### Schizobranchia.

Type, *S. insignis* sp. nov.

##### Eudistylia.

Type, *E. gigantea* sp. nov.



**Metachone.**

Type, *M. mollis* sp. nov.

**Protoplacostegus.**

Type, *P. mörchii* (McIntosh 1885, as *Placostegus*, figures).

**Rhodopsis.**

Type, *R. pusillus* sp. nov. (See Addendum.)

**Metavermilia.**

Type, *M. multicristata* (Philippi 1844, + Marenzeller 1893, as *Vermilia*, figures).

**Paravermilia.**

Type, *P. bermudensis* sp. nov.

**Schizocraspedon.**

Type, *S. furcifera* (Grube 1878, as *Hydroides*, figures).

**Glossopsis.**

Type, *G. minax* (Grube 1878, as *Hydroides*, figures).

## SPECIES NEW TO THE REGION.

*North Pacific.***Bering Sea :**

1. *Spirorbis spirillum* Linné, variety *lucidus* Montagu.  
South to Pacific Grove, California; also Atlantic.

**Alaska :**

2. *Sabella elegans* sp. nov. Kadiak.
3. *Sabella humilis* sp. nov. Popof Island.
4. *Sabella leptalca* sp. nov. Kadiak.
5. *Sabella formosa* sp. nov. Berg or Glacier Bay.
6. *Parasabella media* sp. nov. Kadiak.
7. *Parasabella maculata* sp. nov. Kadiak.
8. *Aspcira modesta* sp. nov. Kadiak.
9. *Schizobranchia insignis* sp. nov. Yakutat south to Victoria, Vancouver Island, British Columbia.
10. *Schizobranchia nobilis* sp. nov. Unalaska Island to Prince William Sound.
11. *Schizobranchia concinna* sp. nov. Prince William Sound.
12. *Schizobranchia dubia* sp. nov. Prince William Sound.
13. *Schizobranchia affinis* sp. nov. Popof Island.
14. *Eudistylia gigantea* sp. nov. Prince William Sound to Yakutat.
15. *Eudistylia plumosa* sp. nov. Sitka.

16. *Eudistylia abbreviata* sp. nov. Yakutat to Sitka.
17. *Chone teres* sp. nov. Unalaska Island.
18. *Myxicola conjuncta* sp. nov. Prince William Sound.
19. *Myxicola glacialis* sp. nov. Unalaska Island.
20. *Serpula splendens* sp. nov. Prince William Sound.
21. *Crucigera formosa* sp. nov. Unalaska Island to Wrangel.
22. *Crucigera irregularis* sp. nov. Juneau.
23. *Hyalopomatopsis occidentalis* sp. nov. Prince William Sound.
24. *Spirorbis semidentatus* sp. nov. Unalaska Island to Sitka.
25. *Spirorbis variabilis* sp. nov. Sitka.
26. *Spirorbis mörchi* Levinsen. Prince William Sound to Sitka; also North Atlantic.
27. *Spirorbis incongruus* sp. nov. Prince William Sound.
28. *Spirorbis quadrangularis* Stimpson. Prince William Sound; also North Atlantic.
29. *Spirorbis lineatus* sp. nov. Prince William Sound.
30. *Spirorbis similis* sp. nov. Prince William Sound.
31. *Spirorbis violaceus* Levinsen. Prince William Sound to Sitka; also North Atlantic.
32. *Spirorbis spirillum* Linné. ? to Santa Barbara, California; also North Atlantic.
33. *Spirorbis rugatus* sp. nov. Sitka.
34. *Spirorbis asperatus* sp. nov. Prince William Sound to Pacific Grove, California.
35. *Spirorbis abnormis* sp. nov. Sitka.

**Puget Sound Region :**

36. *Eudistylia tenella* sp. nov. Vancouver Island, British Columbia.

**California, Pacific Grove :**

37. *Parasabella* sp.
38. *Pseudopotamilla debilis* sp. nov.
39. *Eudistylia intermedia* sp. nov.
40. *Metachone mollis* sp. nov.
41. *Myxicola affinis* sp. nov.
42. *Protula atypha* sp. nov.
43. *Eupomatus gracilis* sp. nov.
44. *Spirorbis eximius* sp. nov.
45. *Spirorbis comptus* sp. nov.

**Mexico :**

46. *Eupomatus humilis* sp. nov.

## Honolulu :

47. *Dasychonopsis pallidus* sp. nov.

*South Pacific.*

## Australia :

48. *Spirorbis inversus* sp. nov.  
49. *Spirorbis tridentatus* sp. nov.

The accompanying heliotype plates are from photographs of the annelids lying under water, that they might appear as life-like as possible, a process developed by Mr. A. H. Verrill, who has also prepared for reproduction most of the camera-lucida drawings of the setæ and opercula.

I am especially indebted to Professor A. E. Verrill and Dr. W. R. Coe, of Yale University, for valuable advice and criticism, and to Mr. J. Percy Moore, of the University of Pennsylvania, for many courtesies, especially the great privilege of studying some of his North Greenland and Japanese forms.

YALE UNIVERSITY MUSEUM,  
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## ANNELIDS OF THE TRIBES SABELLIDES AND SERPULIDES.

### SYSTEMATIC DISCUSSION.

#### Tribe SABELLIDES.

#### Family SABELLIDÆ.

Attempts have been made by several authors to arrange the many and varied forms belonging to this group in analytical tables convenient for interpretation.

Grube (1851) placed them all in *Sabella*, dividing and subdividing the genus according to the form of the branchial lobes. Krøyer (1856) separated the northern forms into various known genera, proposing the name *Bispira* for those having the branchial lobes equal and coiled spirally: "Foruden disse fæm Grupper mener jeg, at de Sabel-ler, hos hvilke begge Gjællebuskene danne Spiraler, må udgjøre en sjætte Slægt, hvilken man måske kunde Kalde *Bispira*."<sup>1</sup> He also described many new species which he referred to the genus *Sabella*. As no definite species was mentioned as type, and also as many of the species referred by him and others to the genus *Sabella* have been found to have their branchial lobes spiral or involute in retraction, it is

<sup>1</sup>This name *Bispira*, suggested by Krøyer (1856—*nomen nudum*), without adequate description or reference to any species, as cited above, was first used by Claparède (1870) for *Bispira volutacornis* (Rathke, 1843), supposing this to be the same as *Amphitrite volutacornis* Montagu (1804) given by Quatrefages (1865) as the first species under his genus *Distylia*, ignoring the fact that Krøyer had called attention to their being distinct. Saint-Joseph (1894), notwithstanding he mentions these facts, combines the two genera, making *volutacornis* Montagu the type of the genus *Bispira*, eliminating the *volutacornis* Rathke as it is synonymous with the *rubropunctata* Grube and referable to the genus *Jasmineira* Langerhans (1880), type *J. caudata* Langerhans. Other authors — Langerhans (1880), Lo Bianco (1893), and Johnson (1901) — have added to the confusion by applying *Bispira* to still other forms, which should be referred to as many distinct genera. It is therefore deemed desirable to restore *Distylia* for the *volutacornis* Montagu, and if *Bispira* is to be considered, it apparently should be studied in connection with its relation to *Jasmineira*.

not surprising that this name (*Bispira*) has been applied by subsequent writers to various distinct forms. Quatrefages (1865) made a careful study of all the then known genera and species, giving descriptions and some figures, also a good analytical table. He, however, ignored the name *Bispira* of Krøyer, and proposed the new genus *Distylia* for forms having the branchial lobes equal and coiled spirally, describing and figuring the (*Amphitrite*) *Sabella volutacornis* Montagu (1804) as the first species. Malmgren (1865-7) made the greatest advance toward a possible correct interpretation of the northern forms by introducing many new genera, giving excellent figures of the species, especially of the setæ, and referring most of Krøyer's new species to those already described by Sars and others. Langerhans (1884) was the first to attempt an analytical table based on the arrangement and form of the setæ. His knowledge of the genera, however, being derived largely from published descriptions and figures, which often proved inadequate, he cannot be followed with certainty. He makes no mention of *Distylia*, and places *Bispira* in his second grand division, far removed from the related genus *Spirographis*, which differs in having the branchial lobes unequal and but one spirally coiled. His conception of *Bispira* was probably suggested by Claparède, and is evidently not that of Saint-Joseph (1894). The latter author has, by studying the animals themselves, been able to correct many of the errors hitherto overlooked. He follows Langerhans in making the arrangement and form of the setæ of great importance, but finds it necessary to introduce several new genera for the reception of the various species. In his analytical table there are some misconceptions which it seems desirable to note. Under his second division the presence and position of the eyes are made a distinguishing character, whereas it often happens that species referable to the same genus may or may not possess them. The genus *Fabricia* Blainville (1828), being said to have no collar, is separated from *Oria* Quatrefages (1865), although Bourne (1883) gives a good figure showing it to possess one. The two genera *Demonax* and *Parachonia* of Kinberg are not mentioned.

A special division was necessary for the genus *Protulides*, as it was described by Webster (1884) as having avicular uncini and pennoned setæ in all the tori of the body. Numerous specimens from Bermuda, recently studied, agree perfectly with Webster's description and figures of the type species (*P. elegans*) with the exception that they have avicular uncini only in the abdominal tori. Webster states that his description is based largely on notes made on specimens from Beaufort, North Carolina. Andrews in 1891, however, in studying specimens from

Beaufort, found that they differed from Webster's description in this same character (avicular uncini only in the abdominal tori). As it is hardly possible that two species would be found in the same two localities, which differ only in the same character, it is safe to assume that the author's notes were at fault. It is therefore necessary to change this character in the descriptions of both the genus and the species. This change reveals the strong similarity between this genus and *Hypsicomus* Grube (1870) and Marenzeller (1884), *non* Ehlers (1887), the two differing but little in form and arrangement of the setæ, but the collars are distinctly unlike. In *Protulides* it is of uniform depth, like that of *Chone* and *Euchone*, and complete save the dorsal opening, while in *Hypsicomus* it has a somewhat undulating edge and ends in a ventral lobe on each side of the ventral fissure or cleft. McIntosh in his Challenger Report (1885) figures a seta and uncinus from a specimen (*Laonome hæckelii*) from St. Vincent, Cape Verde Islands, of which only the tail was found. The uncinus is given in a three-quarter view, so that it is foreshortened. The same result was noticed in mountings of the Bermuda species (*Protulides elegans*), but pressure turned the uncini, showing them in profile to have a posteriorly elongated base. Ehlers (1887) and Saint-Joseph (1894) referred McIntosh's species to *Hypsicomus*; it is, however, identical with *Protulides elegans* Webster. Notwithstanding the extended study given by Saint-Joseph and the excellent results obtained, it has been found impossible to place some of the new forms within the prescribed limits of his analytical table. This is also true of several previously described species. The genus *Eudistylia*, having equal spirally coiled branchial lobes and two kinds of dorsal thoracic setæ, should combine with *Distylia* (*Bispira*) in his division I-A-b, but there no eyes are mentioned, and the dorsal setæ in the type (*D. volutacornis*) are superior 'limbate,' inferior 'cimeter' shaped, the latter commencing on the fifth segment, while in the present form the inferior ones are spatulate back of the collar fascicle, similar to those found in *Pseudopotamilla reniformis*, as figured by Malmgren (1867). This species has, however, simple branchial lobes, and is placed in his second division under *Potamilla*.

In my studies it has appeared impractical to place too much importance on the kinds of setæ alone, as the same forms are repeated in so many different genera. It has seemed desirable to give more consideration to the form of the branchial lobes and the branchiæ themselves. In all the typical *Sabellas* studied the rachises of the branchiæ are distinctly four-sided, connected along their posterior portions by a deli-

cate membrane or web; in the *Parasabellas* these change to less distinguishable four-sided ones, and the web is but slightly developed or disappears, while in the *Eudistylas* they become distinctly three-sided, rounded outwardly. They may also be simple, or many times divided or split, as in the *Schizobranchias*.

It has also been found that, although so many valuable facts have been so comprehensively presented by Saint-Joseph, there are still some genera of which little is known, owing principally to the too broad application by their authors, as evinced by the variety of forms referred to them. This confusion has been greatly increased by subsequent writers, none having restricted the genera to any one of the species as a type, nor published figures as an aid toward a possible correct interpretation. This is especially true of the genera *Sabellastarte* and *Demonax*.

*Sabellastarte* was proposed by Savigny (1809) as a group or divisional name for Sabella-like forms having the branchiæ arranged in a double series. It was adopted as such by Grube and Quatrefages, but Saint-Joseph, following Kröyer, used it as a generic name, without presenting any additional facts in regard to the branchial lobes, form of the collar, or form and arrangement of the setæ. The two species — *Sabella indica* Savigny and *Sabella magnifica* Shaw — apparently agree only in having very long and numerous branchiæ arranged in a double series. The numerous figures given by Shaw show an interesting and easily noted character, *i. e.*, the absence of pinnæ on the slender banded rachises. Neither Quatrefages (1865) nor Marenzeller (1884) mentions such a peculiarity as belonging to *S. indica*, thus giving emphasis to the small importance of the arrangement of the branchiæ as the *only* generic character.

Marenzeller describes *S. indica* as having from 60 to 84 (in different individuals) very long branchiæ arranged in a double series, and equal to about half the entire length of the body, which consists of from 196 to 227 segments and measures from 80 to 135 mm. in length. Quatrefages gives the setæ as lanceolate in form, avicular uncini only in the tori and the collar as four-lobed. It is proposed to restrict the genus to this species as type. The genus *Eurato* Saint-Joseph (1894) differs in not having the branchiæ arranged in a double series. Seven species are included in this *without* mentioning any special one for a type.

Kinberg (1866) placed five species in his genus *Demonax*, the first (*D. krusensterni*) and the last (*D. cooki*) being the only two that from the descriptions appear to be at all alike. Therefore the



genus is restricted to these two species, with the first taken as type. But, as no figures have been given, we can form no definite conception of the form and arrangement of the setæ or of other important features, showing the great need of a more careful study of these species.

In constructing the following analytical table for the genera which are related to the genus *Sabella*, an attempt has been made to base it on characters which can be readily seen with the aid of a good pocket lens, the tables hitherto published being so complicated as to require much careful microscopic work before one can arrive at the generic relation of any species.

In studying the various forms representing the numerous genera, certain details in structure are found to be repeated a certain number of times, forming a definite sequence or continuous evolution, as in the development of the collar.

Taking the form without a collar as the primitive type, the anterior edge of the first segment becomes more or less elongated in front, forming one or two more or less conspicuous lobes. When a collar begins to develop, the entire anterior edge may be produced into a free margin without any openings; or one incision or cleft may occur, forming an opening on the back, the ends being in contact or meeting; or only a portion along the sides and in front may be produced, forming a collar open on the back with widely separated ends. The same process of development taking place in the anterior margin of the first segment of the two-lobed type will produce a two-lobed collar, either with ends in contact or separated on the back. When additional incisions or clefts develop on the sides of either of these two-lobed forms, two corresponding four-lobed collars are formed, those with separated ends usually having the lateral incisions toward the front (ventro-lateral), while in those where the ends are in contact the incisions are toward the back (dorso-lateral). It therefore seems desirable to use the collar as an important character in grouping the genera. Other characters also of these primitive forms are found to be repeated; the setæ and uncini especially, or variations of them, being repeated many times in various combinations which can be arranged in definite groups.

It will be found that the concise facts in regard to many of the 36 genera cited are much too meager to render it possible for one to place each genus in its exact or correct relative position. There is still much work to be accomplished before a perfect analytical table can be formulated.

## ANALYTICAL TABLE FOR SABELLA AND RELATED GENERA.

1. Collar absent..... 2.
- 1'. Collar present..... 3.
2. Anterior edge of first segment produced in front, forming a small angular ventral lobe.  
Uncini in tori on abdomen; beaked setæ in tori on thorax.  
(1) MYXICOLA (Koch 1846) Grube 1855 + Malmgren 1865, including *Leptochone* Claparède 1870, *teste* Marenzeller 1893.  
Type, *M. infundibulum* (Montagu 1808, figures) Koch 1846 + Saint-Joseph 1898, figures. Greenland.  
Branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, lanceolate in form, *i. e.*, tapered, more or less elongated, widest near lower end of blade. Uncini similar in form to those of *Leu-cariste* Malmgren 1865 (Terebellacea). Ventral setæ on thorax with broadened curved (beaked) end, more or less serrate on top, on a long, nearly straight shaft or manubrium, similar to those of *Terebellides*.
- 2'. Anterior edge of first segment produced in front, forming two long, pointed, ventral lobes.  
Uncini in tori on abdomen; uncini and pennoned setæ in tori on thorax.  
(2) AMPHIGLENA Claparède 1864.  
Type, *A. armandi* Claparède 1864, figures, = *A. mediterranea* (Leydig 1851) Claparède 1864 + Langerhans 1880, figures, + Bourne 1883, figures, + Saint-Joseph 1894, figures. Gulf of Naples.  
Branchiæ free. Inferior setæ on thorax, below collar fascicle, lanceolate in form. Uncini avicular in form, those on the thorax the larger.
3. Collar entire, without incisions or clefts.  
Pectinate setæ in tori on abdomen; beaked setæ in tori on thorax.  
(3) HAPLOBRANCHUS Bourne 1883.  
Type, *H. aestuarius* Bourne 1883, figures. Coast of Isle of Sheppey, England, and mouth of Liffey, Ireland.  
Branchial lobes small, bearing *few* ciliated (without pinnæ) branchiæ; one eye on ventral surface of each lobe, beneath collar. Inferior setæ on thorax, below collar fascicle, lanceolate in form. Setæ in thoracic tori approaching the form found in *Trichobranchus* Malmgren 1865 (Terebellacea); setæ in abdominal tori with laterally serrate broadened end, on long shaft or manubrium, approaching that in *Lagis* Malmgren 1867 (Amphictenea) with the elongated base of that form turned downward as a shaft or manubrium.
- (4) MANAYUNKIA Leidy 1858 and 1884.  
Type, *M. speciosa* Leidy 1858 and 1884, figures. Schuylkill River at Philadelphia, Pennsylvania, and Egg Harbor River, New Jersey.  
Branchial lobes laterally elongated, bearing *numerous* ciliated (without pinnæ) branchiæ; 7 eye-spots on each lobe. Young resembling *Haplobranchus*. Setæ somewhat resembling those of *Haplobranchus*.
- 3'. Collar open on back, either with or without incisions or clefts..... 4.
4. Collar open on back, without incisions or clefts (one-lobed)..... 5.

- 4'. Collar open on back, with one or more incisions or clefts..... 6.  
 5. Collar with ends separated on back.

Pectinate setæ in tori on abdomen; beaked setæ in tori on thorax.

(5) *FABRICIA* Blainville 1828.<sup>1</sup>

Type, *F. fabricii* (Müller) Fabricius 1780, figure. Greenland.

Branchial lobes small, bearing few branchiæ with unequal, more or less alternating, pinnæ. Setæ similar to those of *Manayunkia*.

Uncini in tori on abdomen; beaked setæ in tori on thorax.

(6) *ORIA* Quatrefages 1865 + Claparède 1870.

Type, *O. armandi* (Claparède 1874, figures) Quatrefages 1865 + Claparède 1870 + Langerhans 1880, figures, + Saint-Joseph 1894, figures. Gulf of Naples.

Branchial lobes with branchiæ similar to those of *Fabricia*. Setæ also similar to those of *Fabricia*. Uncini somewhat similar in form to those of *Ampharete* or *Amphicteis* Malmgren 1865 (*Ampharetea*).

(7) *ORIOPSIS* Caullery and Mesnil 1896.<sup>2</sup>

Type, *O. metchnikowi* Caullery and Mesnil 1896, figures. St. Vaast-la-Hougue, northern coast of France.

Branchial lobes small, bearing few branchiæ. Inferior setæ on thorax, below collar fascicle, lanceolate in form. Beaked setæ somewhat similar in form to those in *Jasmineira*. Uncini somewhat similar in form to those of *Artacama* Malmgren 1865 (*Terebellacea*), with more numerous teeth.

Uncini only in tori on both abdomen and thorax.

(8) *EURATO* Saint-Joseph 1894 (restricted).

Type, *E. pyrrhogaster* (Grube 1878,<sup>3</sup> figures) Saint-Joseph 1894, as first species. Philippine Islands.

Branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, 'suboval' in form. Uncini avicular in form.

- 5'. Collar with ends meeting, or in contact on back.

Uncini in tori on abdomen; beaked setæ in tori on thorax.

(9) *CHONE* Kröyer 1856.

Type, *C. infundibuliformis* Kröyer 1856 + Malmgren 1865, figures, and 1867, figure. Spitzbergen.

Branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, spatulate in form, *i. e.*, short, rounded, widest in middle or near upper end.

(10) *MEGACHONE* Johnson 1901.

Type, *M. aurantiaca* Johnson 1901, figures. Puget Sound.

Branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, lanceolate in form. Uncini similar to, or approaching

<sup>1</sup> Good figures are given by Bourne 1883 and Leidy 1884.

<sup>2</sup> Although the collar is described as rudimentary or wanting, and no figures are given, this genus is placed here conditionally, as it is said to possess some characters similar to those in *Oria*.

<sup>3</sup> The collar is neither described nor figured with sufficient exactness for one to determine its true character.

the form of those in *Chone*. Intermediate between those of *Chone* and *Euchone*.

(11) *EUCHONE* Malmgren 1865.

Type, *E. analis* (Krøyer 1856) Malmgren 1865, figures, as first species. Spitzbergen.

Branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, subspatulate in form, *i. e.*, short, tapered, widest in middle. With caudal sucker.

(12) *METACHONE* gen. nov. (See p. 216.)

Type, *M. mollis* sp. nov., figures. Pacific Grove, California.

Branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, clavate in form, *i. e.*, long, rounded, widest near upper end. Uncini similar in form to those of *Euchone*. Without caudal sucker.

(13) *PARACHONIA* Kinberg 1866.<sup>1</sup>

Type, *P. letterstedti* Kinberg 1866. Cape of Good Hope.

Branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, clavate in form. Uncini unknown.

(14) *JASMINEIRA* Langerhans 1880.

Type, *J. caudata* Langerhans 1880, figures. Madeira.

Branchiæ free. Inferior setæ on thorax, below collar fascicle, subspatulate in form. Uncini avicular in form.

(15) *DIALYCHONE* Claparède 1870.

Type, *D. acustica* Claparède 1870, figures. Gulf of Naples.

Branchiæ free. Inferior setæ on thorax, below collar fascicle, clavate in form. Uncini somewhat similar in form to those of *Sabellides* Malmgren 1865 (*Ampharetea*), with smaller and more numerous teeth, the lowest one larger than the others.

Avicular uncini in tori on abdomen; avicular uncini and pennoned setæ in tori on thorax.

(16) *PROTULIDES* Webster 1884.<sup>~</sup>

Type, *P. elegans* Webster 1884, figures. Beaufort, North Carolina, and Bermuda. See p. 184.

Branchiæ joined by membranous web. Setæ on collar in a dorsal, oblique, linear series on each side. Inferior setæ on thorax, below collar fascicle, suborbicular in form.

6. Collar with only one incision or cleft (two-lobed)..... 7.

6'. Collar with three incisions or clefts (four-lobed) ..... 8.

7. Collar with ends separated on back.

Uncini only in tori on both thorax and abdomen.

(17) *LAONOME* Malmgren 1865, *non* Kinberg 1866 *nec* Marenzeller 1884.

Type, *L. krøyeri* Malmgren 1865, figures. Spitzbergen.

Branchiæ free. Inferior setæ on thorax, below collar fascicle, orbicular in form. Uncini similar in form to those of *Euchone*.

<sup>1</sup> A thorough knowledge of this genus may render it necessary to combine it with the preceding (*Metachone*).

- (18) *DEMONAX* Kinberg 1866 (restricted).<sup>1</sup> (See p. 186.)

Type, *D. krusensterni* Kinberg 1866. Honolulu.

Branchiæ free, without outer appendages. Inferior setæ on thorax, below collar fascicle, lanceolate in form.

- (19) *DASYCHONOPSIS* gen. nov. (See p. 198.)

Type, *D. pallidus* sp. nov., figures. Honolulu.

Branchial lobes small, not spiral; branchiæ free, with outer appendages. Inferior setæ on thorax, below collar fascicle, lanceolate in form. Avicular uncini in tori on abdomen; avicular uncini and pennoned setæ in tori on thorax.

- (20) *BRANCHIOMMA* (Kölliker 1858) Claparède 1870.

Type, *B. vesiculosum* (Montagu 1815, figures) Claparède 1870, figures, + Langerhans 1884, figures + Saint-Joseph 1894, figures. Kingsbridge, south coast of Devonshire, England.

Branchiæ free; eyes subterminal. Inferior setæ on thorax, below collar fascicle, ob lanceolate in form, *i. e.*, tapered, widest in middle, differing in length.

- (21) *PARASABELLA* gen. nov. (*Potamilla* Malmgren 1865, in part, + Marenzeller 1884, in part). (See p. 199.)

Type, *P. media* sp. nov., figures. Alaska.

Branchiæ joined by a small membranous web; eyes, when present, on outer surface of the rachises. Inferior setæ on thorax, below collar fascicle, ob lanceolate in form.

7'. Collar with ends meeting or in contact on back.

Avicular uncini only in tori on both thorax and abdomen.

- (22) *PARALAONOME* gen. nov. (*Laonome* Kinberg 1866 and Marenzeller 1884.) (See p. 197.)

Type, *P. japonica* (Marenzeller 1884, figures). Japan.

Branchial lobes forming equal spirals. Inferior setæ on thorax, below collar fascicle, lanceolate in form.

- (23) *NOTAULAX* Tauber 1879 + Levinsen 1883 (revised).

Type, *Notaulax* sp. Tauber 1879 = *N. rectangularis* Levinsen 1883, figures.

Branchiæ free. Setæ on collar in dorsal, angular, linear series on each side. Inferior setæ on thorax, below collar fascicle, spatulate in form. Avicular uncini in tori on abdomen; avicular uncini and pennoned setæ in tori on thorax.

- (24) *HYPSICOMUS* Grube 1870 + Marenzeller 1884, *non* Ehlers 1887.

Type, *H. stichophthalmos* Grube 1863, figure, as first species. Adriatic Sea.

Branchiæ joined by membranous web. Setæ on collar in dorsal, oblique, linear series on each side. Inferior setæ on thorax, below collar fascicle, 'broad oval' in form.

<sup>1</sup> At the present time very little is definitely known of this genus.

- (25) *POTAMILLA* Malmgren 1865 (restricted).

Type, *P. neglecta* (Sars 1861) Malmgren 1865, figures, as first species. Off Finmark, in 20-40 fms.

Branchiæ free. Inferior setæ on thorax, below collar fascicle, subspatulate in form, *i. e.*, short, tapered, widest in middle.

- (26) *ASPEIRA* gen. nov. (*Potamilla* Malmgren 1865, in part). (See p. 202.)

Type, *A. modesta* sp. nov., figures. Alaska.

Branchiæ free. Inferior setæ on thorax, below collar fascicle, subspatulate to oblanceolate in form, *i. e.*, tapered, widest in middle, varying in length.

# 8. Collar with ends separated on back.

Incisions or clefts ventro-lateral and ventral.

Avicular uncini only in tori on both abdomen and thorax.

- (27) *SABELLASTARTE* Savigny 1809 + Saint-Joseph 1894. (See p. 186.)

Type, *S. indica* Savigny 1809, as first species, + Quatrefages 1865. Indian Ocean.

Branchial lobes comparatively small, spiral only in retraction. Inferior setæ on thorax, below collar fascicle, lanceolate in form. Uncini similar to those of *Pseudopotamilla*.

- (28) *METALAONOME* gen. nov.

Type, *M. mariæ* (Lo Bianco 1893, as *Bispira*, figures). Gulf of Naples. Branchial lobes spiral only in retraction. Inferior setæ on thorax, below collar fascicle, oblanceolate in form.

- (29) *DASYCHONE* Sars 1861 + Malmgren 1865 (restricted).

Type, *D. decora* Sars 1861, as first species, = ? *D. infarcta* (Krøyer 1856) Malmgren 1865, figures. Coast of Norway.

Branchial lobes forming equal spirals; branchiæ with outer appendages. Inferior setæ on thorax, below collar fascicle, lanceolate in form.

Avicular uncini in tori on abdomen; avicular uncini and pennoned setæ in tori on thorax.

- (30) *SABELLA* (Linné) Malmgren 1865.

Type, *S. pavonina* Savigny 1809 + Malmgren 1865, figures, as first species. Coast of Norway, in 30-100 fms.

Branchial lobes spiral only in retraction; branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, lanceolate in form.

- (31) *DISTYLIA* Quatrefages 1865 (*Bispira* Saint-Joseph 1894). (See p. 183.)

Type, *D. volutacornis* (Montagu 1804, figures) Quatrefages 1865, figures. South coast of Devonshire, England.

Branchial lobes forming equal spirals. Inferior setæ on thorax, below collar fascicle, lanceolate in form.

- (32) *SPIROGRAPHIS* Viviani 1805.

Type, *S. spallanzanii* Viviani 1805, figures, + Claparède 1870, figures, + Saint-Joseph 1898. Gulf of Naples.

Branchial lobes forming unequal spirals; branchiæ joined by membranous web. Inferior setæ on thorax, below collar fascicle, lanceolate in form.

## 8'. Collar with ends meeting or in contact on back.

Incisions or clefts dorso-lateral and ventral.

Avicular uncini in tori on abdomen; avicular uncini and pennoned setæ in tori on thorax.

## (33) POTAMIS Ehlers 1887.

Type, *P. spatkiferus* Ehlers 1887, figures. Off the coast of Florida, in 275 fms.

Branchial lobes small; branchiæ free, unequal. Inferior setæ on thorax, below collar fascicle, orbicular in form. Avicular uncini on thorax in form intermediate between those of *Jasmineira* (as in *J. oculata* Langerhans 1884) and those of *Pseudopotamilla* (as in *P. oculifera* Leidy 1855).

(34) PSEUDOPOTAMILLA gen. nov. (*Potamilla* Malmgren 1865, in part). (See p. 203.)

Type, *P. reniformis* (Leuckart 1849, figures, + Malmgren 1867, figures). Iceland.

Branchial lobes small; branchiæ simple, free, equal. Inferior setæ on thorax, below collar fascicle, spatulate in form.

## (35) SCHIZOBRANCHIA gen. nov. (See p. 205.)

Type, *S. insignis* sp. nov., figures. Alaska.

Branchial lobes small; branchiæ free, divided. Setæ similar in form to those of *Pseudopotamilla*.

## (36) EUDISTYLIA gen. nov. (See p. 209.)

Type, *E. gigantea* sp. nov., figures. Alaska.

Branchial lobes produced ventrally, forming equal spirals; branchiæ in nearly uniform double series. Setæ similar to those of *Pseudopotamilla*, i. e., inferior setæ on thorax, below collar fascicle, spatulate in form.

Genus *Sabella* Malmgren 1865.

Type, *Sabella pavonina* Savigny.

In this genus the branchial lobes are small at base, free and more or less prolonged ventrally, spirally coiled or involute in retraction, more or less flaring when fully expanded.

The branchiæ are nearly equal in length, arranged in a single series, their rachises four-sided, being flattened on the back, the two outer angles furnished with thin membranous edges, most developed and sometimes ruffled along their anterior or distal portions, where they frequently fold outward, toward each other, forming a conspicuous groove. The two inner edges bear slender, more or less crowded pinnae which do not extend to the end, leaving a thin, flattened, more or less bluntly rounded tip. They are connected along their posterior or proximal portions by a more or less developed, thin, interbranchial membrane or web. Eyes usually present, arranged in pairs on the back, often concealed by color spots.



Collar four-lobed, circular, with a slightly undulating rolling edge, the lateral slits in front of the fascicles of setæ, or ventro-lateral, often marked by a spot of color; ventral lobes small; dorsal lobes wanting, the ends widely separated on the back, showing the cephalic region with a deep median furrow defined by a conspicuous ridge on each side. Inside the collar, opposite the ventral fissure, is a small, triangular, median, somewhat bilobed cephalic swelling, often with two conspicuous spots of color, bordered by a thin, often ruffled membrane. Extending inward from this, along the base of each branchial lobe, is a thin, moderately developed, often much ruffled membrane, which, folding on itself, terminates at the ventral end of the lobe. Mouth protected on each side by a moderately developed membranous lobe supporting a very long, conspicuous, regularly tapered dorsal tentacle.

Fascicles of setæ forming oblique series on the thorax, of two forms, the superior ones linear, the inferior round and protected by an auri-form membrane; those on the abdomen comma-shaped.

All the setæ limbate, of one form, long, regularly tapered, lanceolate, the two equal sides, seen only in a direct front or back view, appearing as a single border, as given by Malmgren in a direct profile view; varying in width, the superior ones much narrower than the inferior and fewer in number; on the abdomen they are less regularly tapered. Along the tori on the thorax are two forms, avicular hooks and pennant-bearing or pennoned<sup>1</sup> setæ; on the abdomen avicular hooks only.

A typical example of the type (*Sabella pavonina* Savigny 1809) has not been seen. The above description refers to forms like *Sabella crassicornis* Sars (1851).

*Sabella melanostigma* Schmarda (1861), given by Ehlers (1887) as a typical example of his interpretation of this genus, Saint-Joseph (1894) placed in his new genus *Eurato*, under the second group in his analytical table, for genera having avicular hooks only in the thoracic tori. Treadwell (1901) recorded this species from Porto Rico.

#### SABELLA ELEGANS sp. nov.

Pl. xxvi, fig. 2; Pl. xxvii, fig. 6c; Pl. xxxiii, figs. 20, 21; Pl. xxxiv, figs. 1, 4, 5, 10; Pl. xxxvii, figs. 12, 33.

*Type locality.* — Kadiak.

<sup>1</sup> These setæ of the tori have the exposed end of the long shaft or manubrium expanded into a short, more or less cordate-shaped, usually striated portion, bearing a long transparent, flexible, pennant-like terminal portion. 'Cucullate,' 'mucronate,' 'en pioche,' and other terms have been used as descriptive of them.



Color white, with the branchiæ tinged with pink and conspicuously spotted with dark purple, forming bands.

Number of segments about 80, of which 8 belong to the thorax.

The branchiæ number about 22 in each lobe, not counting the 3 or 4 small ones at the lower or ventral end. They are about 16 mm. long, broad and flat on the back, with the membranous edges ruffled and very conspicuously developed along their distal portions.

Eyes in pairs, situated in the color spots, so that they are not readily found.

Length of figured specimen 2.25 inches; breadth at base of collar about 7.5 mm.; length of thorax along setæ 7 mm.

Kadiak, July 3, four specimens.

This species closely resembles *Sabella crassicornis* Sars, as figured by Malmgren (1865), but has more numerous branchiæ and color spots. It is easily distinguished from the other species of this region by the regular arrangement of the color spots on the rachises and the extending of the color onto the pinnæ, which is unusual.

#### SABELLA HUMILIS sp. nov.

Pl. xxvii, fig. 2; Pl. xxxvi, figs. 4-11.

*Type locality*. — Popof Island.

Compared with the smallest specimen of *S. elegans*, which has about 50 segments (7 on the thorax) in a length of 15 mm. and a breadth of about 2.5 mm., this species is shorter, having 55 segments (8 on the thorax) in a length of 11 mm. and breadth of 2 mm.

The branchiæ, though of similar form, length, and number (12 pairs), have the basal membrane more developed and but three series of unequal-sized spots of color, on most of which a pair of eyes is situated, while the former has six series of color spots of about equal size, and regular in arrangement. There is also a noticeable contrast between the prevailing colors — deep crimson in the present species, and pale yellowish white in *S. elegans*.

The tube is thin, horn-color, with a coating of very fine grey sand. Popof Island, July 8, one specimen, dredged.

#### SABELLA LEPTALEA sp. nov.

Pl. xxvii, fig. 6a; Pl. xxxiii, figs. 5, 14, 27, 29; Pl. xxxiv, figs. 6-9, 22.

*Type locality*. — Kadiak.

In form and coloring this species closely resembles *S. formosa* and *S. elegans*, but differs in having the pinnæ of the branchiæ fewer, shorter, and exceedingly delicate.

There are about 90 segments in the largest specimen, of which 8 belong to the thoracic region.

Branchial lobes small, considerably developed ventrally, each bearing about 22 rather long branchiæ, which are connected by a basal membrane; the rachises taper gradually toward the extremity, which often bears a short, very delicate terminal filament; their two thin outer edges are considerably developed and turn outward, especially near the tip; their pinnæ are moderately long, exceedingly slender, and gradually decrease in length.

Eyes single or in pairs on nearly all of the brown color spots, which number from 5 to 8 on different branchiæ.

Length 75 mm.; breadth at base of thorax 10 mm.; length of thorax along setæ about 11 mm.; length of branchiæ about 19 mm.

Kadiak, July 3, three ♀ specimens.

One specimen was taken from its tube, which is very thin and flexible, of a dark purplish brown color, with a coating of very fine gray sand.

#### SABELLA FORMOSA sp. nov.

pl. xxvii, fig 6b; Pl. xxxiii, fig. 32; Pl. xxxiv, figs. 14, 21; Pl. xxxv, figs. 7, 25, 30; Pl. xxxvi, figs. 25, 32.

*Type locality.* — Berg or Glacier Bay.

A large species, similar in size and form to *S. leptalea*, of a beautiful pink color, the branchiæ of a deeper shade, with large brown spots varying in number from 3 to 7 and not evenly spaced, as in *S. elegans*.

In the largest specimen, which is distended with eggs and not very well preserved, there are about 70 segments, of which 8 belong to the thorax.

The branchial lobes arch well forward ventrally, the free portion forming noticeable spirals when unexpanded. The branchiæ, about 29 in each lobe, not counting 4 or 5 undeveloped ventral ones, are comparatively long and slender, with closely crowded, very long and slender pinnæ, which decrease abruptly, leaving relatively short thin ends. Eyes of good size, arranged in pairs on some but not all of the brown spots.

Collar simply rounded at the ventral fissure, without angular lobes, often with spots of brown at the bases of the noticeable lateral clefts.

Length of largest specimen about 100 mm.; branchiæ 23 mm.; breadth at base of thorax about 10 mm. Length of smallest specimen about 47 mm.; breadth about 7 mm.

Berg or Glacier Bay, June 10, four specimens, dredged.

Tubes thin and flexible; brown, with a tinge of pink; joined to each other, covered with exceedingly fine gray sand, to which delicate hydroids are attached.

This is readily distinguished from the other allied forms by the more numerous branchiæ, with their very long crowded pinnæ and irregularly arranged brown spots.

SABELLA (?) VANCOUVERI Kinberg.

*Sabella vancouveri* KINBERG, *Annulata nova*, p. 353, 1866.

*Type locality.* — Vancouver Island, British Columbia.

Nothing corresponding to this species occurs in the present collection.

It was described by Kinberg (1866) as having a stout body; 8 or 9? thoracic segments; 182 branchiæ on both sides, 18–23 mm. long, with 5 purple bands; setæ limbate, hastate; uncini; length of the 36 anterior segments, 60 mm.

No mention is made of the form of the branchial lobes, yet the large number of branchiæ make it improbable that the species can be a typical *Sabella*. No species of *Eudistylia*, however, has more than 3 bands of color on the branchiæ, and those of *Schizobranchia* are not banded.

Genus *Paralaonome* nov.

Type, *Laonome japonica* Marenzeller.

The above species was erroneously referred by Marenzeller to the genus *Laonome* of Malmgren (1865), agreeing with *L. krøyeri* Malmgren, the type, only in having a single series of avicular uncini in all the tori; these differ greatly in form, however, being distinctly prolonged posteriorly, not truncated as in Malmgren's species.

The branchial lobes are large, prolonged ventrally, spirally coiled in retraction, as in *Sabella*, and bear numerous branchiæ arranged in a double series.

The narrow four-lobed collar differs, also, from the much more conspicuous two-lobed one on *L. krøyeri*.

*Paralaonome* is therefore proposed for the reception of the Japanese species, notwithstanding the fact that Saint-Joseph (1894) suggested that it should be referred to the genus *Sabellastarte* Savigny (1809), type *S. indica* Savigny (1809), although it does not appear to agree very closely with the other species placed there.

*Laonome antarctica* Kinberg (1866) from the Straits of Magellan may prove to be a related species.

## PARALAEONOME JAPONICA (Marenzeller).

*Laonome japonica* MARENZELLER, Südjapanische Anneliden, p. 212, pl. III, figs. 4 (A-C), 1884.

*Sabellastarte japonica* SAINT-JOSEPH, Annélides de Dinard, p. 249, 1894.

*Type locality.* — Japan.

Branchial lobes much prolonged ventrally, and spirally coiled in retraction, possibly unrolled in expansion, bearing 100 to 110 or more moderately long branchiæ arranged in two series, their wine-colored rachises slender, four-sided, the two inner edges with closely crowded yellowish pinnæ. Eyes, if present, not discernible.

Collar inconspicuous, four-lobed, the dorso-lateral incisions forming small dorsal lobes separated by a deep furrow; at the ventral fissure simply rounded without angular ends.

Number of segments about 200, of which 8 belong to the thorax, on which the fascicles of setæ, which are circular in form as in *Sabella*, form very oblique series.

Setæ on all of the segments long, regularly tapered, of two forms, narrow and broad. Avicular uncini only in all the tori.

Length, without the branchiæ, of a much contracted specimen 70 mm.; breadth 10 mm.

The above characters are taken from a specimen in the Yale University Museum, and agree well with those given by Marenzeller, differing only in size and number of branchiæ, stated by him to be 144.

Genus *Dasychone* Sars 1861.

Type, *Dasychone decora* Sars = ? *Dasychone infarcta* (Krøyer 1856) Malmgren 1865.

The various species which have been referred to this genus vary so greatly in the size and form of the branchial lobes, the size and arrangement of the outer branchial processes, also the form of the collar, that they need much careful study and separation, probably resulting in the further division of the genus (see p. 192).

Genus *Dasychonopsis* nov.

*Dasychone* MALMGREN 1865, in part.

Type, *Dasychonopsis pallidus* sp. nov.

The type (*D. pallidus*), in its small (not spiral) branchial lobes and bilobed collar, agrees with *Dasychone argus* Sars, as figured by Malmgren (1865). Both are unlike *D. infarcta* (Krøyer), supposed to be identical with *D. decora*, given by Sars in 1861 as his first species and therefore taken as the type of the genus *Dasychone*. This has the

*Dasychone*

branchial lobes much prolonged ventrally, and spirally coiled, and the collar distinctly four-lobed, with conspicuous ventro-lateral and ventral incisions. The name *Dasychonopsis* is therefore proposed for *D. pallidus* sp. nov., as type. *D. compressa* Ehlers (1887) and *D. curta* Ehlers (1901) are related species.

DASYCHONOPSIS PALLIDUS sp. nov.

*Type locality.* — Honolulu.

A small nearly colorless species, with long slender branchiæ about one half as long as body, a little rust color on the branchial lobes and minute darker dots at the outer end of each torus.

Branchial lobes small, not prolonged ventrally, neither spiral nor involute, bearing 9 pairs (18) of branchiæ having slender four-sided rachises, with moderately long, delicate, tapered tips, often curled inward, connected posteriorly by a shallow inconspicuous membrane; slender, well-separated pinnæ along their two inner edges, and comparatively stout tapered processes, forming 5 to 8 pairs, situated at regular intervals along the two outer ones; between the processes a pair of yellowish brown eyes often occur; at the edge of the interbranchial membrane a single long, slender process, turning outward, arises from the dorsal outer edge of each rachis.

Collar two-lobed, without lateral incisions, of nearly uniform depth, arising abruptly just above the dorsal setæ, widely separated, ending in angular ventral flaps.

Number of segments 18, of which 5 belong to the thorax, on which the small circular fascicles of setæ form oblique series.

Collar setæ long, regularly tapered, of two forms, narrow and broad; on the other thoracic segments broad ones only; on the abdomen they are of two forms, similar to those on the collar but much longer; uncini only in all the tori, those on the abdomen with more numerous apical teeth.

Entire length 7.5 mm.; branchiæ about 4 mm.

Kinberg (1866) described *Sabella havaica* from Honolulu as having the outer processes on the branchiæ, characteristic of *Dasychone*. Although similar in size (8 mm.) to the present species, it has 13 branchiæ and 44 segments.

Genus *Parasabella* nov.

Type, *Parasabella media* sp. nov.

This generic name is proposed for species which, though resembling typical Sabellas in form, have the branchial lobes small, but slightly

prolonged ventrally, with the branchiæ not so distinctly four-sided, and connected by a very slightly developed, posterior, interbranchial, membranous web. The collar bilobed, without lateral incisions, widely separated on the back, ending in more or less angular ventral ends.

All the fascicles of setæ laterally elongated.

Setæ on the thorax of two forms; superior ones long, regularly tapered; inferior ones shorter, broader, and oblanccolate. Tori with avicular uncini and pennoned setæ.

*Sabella microphthalmia* Verrill (1874) from the southern coast of New England is a *Parasabella*.

#### PARASABELLA MEDIA sp. nov.

Pl. xxvii, figs. 3-5; Pl. xxxiii, figs. 34-36; Pl. xxxiv, fig. 3; Pl. xxxvi, figs. 13, 14; Pl. xxxvii, fig. 30.

*Type locality*. — Kadiak.

This small species is short and stout, abruptly tapered near the broad posterior end, light brown in color, tinged with crimson, with the branchiæ variously spotted with dark brown.

Segments about 100 in the largest example, of which 8 belong to the thorax, on which the fascicles of setæ form oblique series.

Branchial lobes but slightly prolonged ventrally, bearing about 18 pairs of long, rather slender, much curled and twisted branchiæ; their rachises not so distinctly four-sided as in *Sabella*, and not connected by a noticeable basal membrane or web; pinnæ short, but little developed, leaving long tapered ends. The irregular development of the pinnæ and the curling of the branchiæ are largely, if not entirely, due to the presence of a curious parasite which attaches itself to, and develops in masses along, the thin inner membranous edges of the rachises. These masses are protected by a thin transparent wall. Eyes none; not discernible in preserved specimens.

Collar well developed, without lateral incisions, open on the back, arising abruptly midway between the broad dorsal furrow and the first fascicle of setæ, ending in small, angular, ventral lobes.

Setæ characteristic of the genus, with the exception of the pennoned ones of the thoracic tori, which have one side larger than the other, and developed into a long, slender, terminal filament, which is separated or split at its base, from the pointed end of the shaft or manubrium.

Length of largest specimen about 35 mm.; breadth at base of thorax about 5 mm.; at base of collar 4 mm.; length of thorax along setæ about 5.5 mm. Length of smallest specimens 19 mm.; breadth at base of thorax about 4 mm.

Kadiak, July 3, several specimens. Their tubes, which are semi-transparent, horn color, with more or less foreign matter adhering in patches, are attached in clusters or colonies.

PARASABELLA MACULATA sp. nov.

Pl. xxviii, figs. 8, 9; Pl. xxxiii, figs. 8, 12, 33; Pl. xxxiv, fig. 2; Pl. xxxvi, figs. 12, 15, 16, 21, 22.

*Type locality.* — Kadiak.

A rather long, slender species, yellowish white, with the branchiæ irregularly spotted with brown, each rachis having its two outer edges marked by dashes and spots of dark chocolate brown, and the pinnæ banded with a lighter shade.

Segments rather long and well defined, about 70 in number, of which 8 belong to the thorax, where the fascicles of setæ are in nearly straight series.

Branchiæ about 14 pairs; not joined by a basal web, narrow, without noticeably thinner edges; the pinnæ of moderate length, gradually decreasing toward the end, leaving a comparatively long, rounded, tapered, naked terminal portion.

Eyes not discernible.

Collar well developed, round, of nearly uniform depth, arising abruptly a little above the dorsal fascicles of setæ, and ending in two small ventral lobes.

Oral membrane conspicuous, tentacles long, broad at base, with an opaque, rib-like median portion tapering into the long slender end.

Dorsal furrow conspicuous on the first three segments.

Length about 35 mm.; branchiæ about 10 mm.; breadth at base of thorax 3.5 mm.

Kadiak, July 3, one specimen.

Although so very dissimilar in general appearance, this species is very much like the preceding in the coloring of the branchiæ and form of most of the setæ, but those of the tori do not appear to have the conspicuous split seen in that species (Pl. xxxvii, fig. 30).

PARASABELLA sp.

*Type locality.* — Pacific Grove, California.

A very small colorless specimen, destitute of branchial lobes, has the round bilobed collar and form of setæ characteristic of this genus.

It has 8 thoracic and 50 abdominal segments.

Length 12 mm.; of thorax 3 mm.; breadth 2 mm.



Genus *Aspeira* nov.

Type, *Aspeira modesta* sp. nov.

Branchial lobes with small basal attachment, not spiral, without ventral prolongation, and united dorsally, bearing a single series of moderately long, simple plumose branchiæ of about equal length, their rachises rounded on the back and, along the two inner edges, having a conspicuous ruffled membrane, most developed posteriorly, outside of which the long, rather coarse, well-separated (especially posteriorly) pinnæ arise; these extend nearly to the end of the rachis, leaving but a very small tapered tip. Eyes none.

Collar bilobed, as in *Potamilla*, arising from the dorsal furrow and continuing in an unbroken curve to the ventral fissure, where it abruptly expands into long, narrow, triangular processes, twisted strongly backward. Inside the collar are two well-marked dorsal cephalic swellings.

A conspicuous ruffled membrane extends inward from the ventral fissure of the collar, inside each branchial lobe, folds on itself, and terminates at the ventral end. On each side of the mouth is a very large, irregular, leaf-like membranous lobe supporting a long, slender, dorsal tentacle, which is attached near its base to the inside of the branchial lobe.

Fascicles of setæ laterally elongated as in *Pseudopotamilla* and *Eudistylia*.

Setæ of the collar fascicle and superior ones of the other thoracic fascicles, with regularly tapered, lanceolate blades; inferior setæ, back of the collar, vary from ob lanceolate (the longer) to subspatulate (the shorter) forms; abdominal setæ bent at the base of the long, abruptly tapered blade. Thoracic tori with avicular hooks and penoned setæ; abdominal tori with avicular hooks only.

This genus forms a connecting link between the genera *Parasabella* and *Potamilla*.

*ASPEIRA MODESTA* sp. nov.

Pl. xxv, fig. 3; Pl. xxxvi, figs. 27-31, 33-35.

*Type locality*.—Kadiak.

Color in formalin yellowish, with the branchiæ broadly and irregularly banded with light chestnut.

Number of segments about 90, with 6 on one side of the thorax and 7 on the other; the fascicles of setæ in slightly oblique series.

Branchiæ about 11 mm. in length, arranged in a single series of 13 equal pairs, besides 2 small undeveloped ventral ones.



Length about 46 mm., or 1.6 inches; breadth 5 mm.; length of thorax along setæ about 5 mm.

Kadiak, July 3, one specimen.

Genus *Potamilla* Malmgren 1865.

Type, *Potamilla neglecta* (Sars).

The genus *Potamilla* of Malmgren appears to have been rather vaguely used by subsequent writers. It was proposed in 1865 for the species *Sabella neglecta* Sars (1851), redescribed and figured as the first species, and *Potamilla torelli* Malmgren, which are readily distinguished, especially from species of *Sabella*, by the bilobed collar meeting at the dorsal furrow and by shorter, broader, *subspatulate*, inferior thoracic setæ; their borders, however, being equal, not unequal as given by Malmgren.

It was also suggested that *Sabella reniformis* (Müller) Leuckart might be referable to the same genus, but the excellent figures given in 1867 show a marked difference in the four-lobed collar with deep dorso-lateral incisions or notches, as well as in the shorter, *spatulate* inferior thoracic setæ. The new name *Pseudopotamilla* is therefore proposed for such forms.

All species hitherto referred to *Potamilla* need much careful study before their correct relationship can be determined. *Potamilla malmgreni* Hansen (1882) from N. L. 63-65° +, W. L. 5-7° +, in 1163-1215 fathoms, should be referred to the genus *Potamis* Ehlers (1887).<sup>1</sup> The avicular thoracic hooks are somewhat analogous in form to those in *Euchone*.

Genus *Pseudopotamilla* nov.

Type, *Potamilla reniformis* (Müller + Leuckart) Malmgren.

This generic name is proposed for species similar to *P. reniformis* which have hitherto been referred to the genus *Potamilla*.

The branchial lobes are simple, and not prolonged ventrally, but differ from those in *Potamilla* in having the dorsal ends protected by a stiff, sharp or thin edge, often turning outward. Malmgren's figure 77A, Pl. XIII, 1867, is not sufficiently clear to show this.

The collar is four-lobed, meeting on the back, with small, angular, dorsal lobes formed by conspicuous dorso-lateral incisions or notches, and more or less developed, usually pointed, ventral ends.

<sup>1</sup>Type, *Potamis spathiferus* Ehlers, from off the coast of Florida, in 275 fathoms.

Oral membranes as in *Potamilla* and related genera; one extending inward from each side of the ventral fissure, along the base of each branchial lobe, folding on itself to the ventral end of the lobe; the other, inside this, more or less irregular, leaf-like in form, supporting long, slender, tapered, dorsal ends.

Fascicles of the setæ small, laterally elongated, in straight series; thoracic tori comparatively short, of about uniform length. Inferior thoracic setæ, back of the collar fascicle, spatulate in form.

Müller 1771, as *Amphitrite*, Leuckart 1849, as *Sabella*, Quatre-fages 1865 and McIntosh 1868, as *Sabella saxicava*, Malmgren 1867 + Marion and Bobretzky 1875 + Marion 1878 + Langerhans 1884 + Andrews 1891 and Saint-Joseph 1894, as *Potamilla*, have published figures of this species, but as there appears to be considerable variation in the form of the setæ, especially the uncini, it is probable that the name has been sometimes erroneously applied.

In this genus can be placed *Potamilla oculifera* Leidy (1855), which has long been considered synonymous with *P. reniformis*. Figures of the characteristic setæ of specimens (No. 885 Yale Museum), collected at Watch Hill, Rhode Island, are given on Pl. xxxiii, figs. 6, 30; Pl. xxxiv, fig. 11; Pl. xxxvii, figs. 11, 13, 14, 29. *Potamilla tortuosa* Webster (1878), from the Virginia coast, has similar inferior thoracic setæ, and may possibly belong here. McIntosh (1885) thought this identical with the species from Torquay identified by him as *Sabella saxicava*. *Pseudopotamilla reniformis* (Müller) was recorded from Bering Sea by Marenzeller (1890).

PSEUDOPOTAMILLA DEBILIS sp. nov.

Pl. xxxvi, figs. 23, 24, 26.

*Type locality*.—Pacific Grove, California.

A long, slender, delicate, nearly colorless specimen, has only faint indications of brown along the distal portion of the branchiæ, which number about 16 in each lobe and are very long (about 7.5 mm.) and very slender, with long, delicate, well-separated pinnæ and a few scattered eyes.

The collar has very wide dorso-lateral notches and long, narrow, pointed, ventral ends.

There are 8 thoracic and over 50 abdominal segments (extremity mutilated).

Length of thorax along setæ about 4 mm.; breadth about 2.5 mm.

? *Ps. oculata*  
? *Ps. reniformis*

Genus *Schizobranchia* nov.

Type, *Schizobranchia insignis* sp. nov.

The three most typical species (*insignis*, *nobilis*, and *concinna*) of this genus are remarkable for their large size and beautiful deep wine-colored, much-divided branchiæ.

The small, nearly semicircular branchial lobes are simple, not spiral, and bear long branchiæ, stout at base, often irregularly arranged in two series and usually regularly dichotomously divided from 1 to 6 times, so that the tips number several hundred. The ends of the lobes are stiffened and protected by conspicuous, usually white, cartilaginous edges.

The two much smaller species (*dubia* and *affinis*), however, and the young of these large forms, do not have all the branchiæ forked, but some are simple, thus showing a connecting link with species of typical *Pseudopotamilla*, in which all the branchiæ are simple.

Eyes numerous, varying in size and arrangement along the back of most of the rachises of the branchiæ.

Mouth protected on each side by three deep membranous frills or folds. The two outer ones form a single membrane, which is attached at one end to the inner surface of the ventral edge of the branchial lobe, extends inward along the base of the lobe to about the middle, then, folding on itself, terminates at the collar fastened to the side of the ventral fissure. The inner one, next the mouth, is large, irregular, somewhat leaf-like in form, deepest ventrally and abruptly tapered into a long narrow end; dorsally bearing a delicate filamentose tentacle, which arises from the inner surface of the dorsal edge of the branchial lobe.

Collar four-lobed, as in *Eudistylia* and *Pseudopotamilla*; deepest along the sides beyond the small, angular, dorsal lobes, curving more or less broadly and abruptly forward from the dorso-lateral notches, ending in small angular processes on each side of the shallow ventral fissure.

Body long and usually slender, more or less compressed dorso-ventrally, very gradually tapered to the pointed posterior end. Dorsal groove most conspicuous on the first segments. Fascicles of setæ similar in form to those of *Eudistylia* and *Pseudopotamilla*, usually in a nearly straight series on the sides of the thorax, often oblique in much contracted specimens.

Setæ similar in form to those of *Pseudopotamilla*.

Chitinous tubes usually solitary when fully developed, twisted about one another in colonies or groups when immature; thick along their

lower embedded portions, of a rusty brown color, much thinner above, of a light horn color, sometimes tinged with wine color, covered with a thin layer of fine gray sand, to which small hydroids, ascidians, and seaweeds adhere; within, sometimes beautifully iridescent or silvery.

SCHIZOBRANCHIA INSIGNIS sp. nov.

Pl. xxiv, figs. 1, 2; Pl. xxvii, fig. 1; Pl. xxviii, fig. 5; Pl. xxxv, figs. 2, 12, 13, 15, 16, 26, 27.

*Type locality*. — Yakutat.

This large species is light brown in color, more or less tinged with pink, with the branchiæ sometimes of the same tone but usually of a deep wine color.

Segments short, flattened, numbering about 180 in the largest specimens, of which 8 belong to the thorax; in those of medium size the number varies from 6 to 8.

Branchiæ stout at base, comparatively short, the larger portion of them of nearly uniform length, measuring 17 mm. They are often arranged somewhat biserially, and number about 16 in the outer or regular series; in immature specimens the number often differs in the two lobes. Each rachis is usually regularly dichotomously divided from one to four times, so that there may be between 200 and 300 terminal branches (occasionally one occurs which has three primary divisions); the pinnæ are long and slender, crowded distally, forming very blunt, broadly rounded ends, which are often much twisted.

Eyes large, numerous, irregularly placed on the back of most of the rachises, principally along the posterior portion.

Collar very deep at the sides, at the end of the slightly developed dorsal lobes.

Fascicles of setæ in slightly oblique series on the thorax.

Many of the specimens have eggs showing along the abdominal tori.

Length of a perfect specimen about 158 mm., or 6.25 inches; breadth at base of collar about 7 mm.; length of thorax along setæ about 14 mm. A young, much contracted specimen has 18 pairs of branchiæ, all forked, the longest twice. It is about 5 mm. in breadth, and has 8 thoracic and 80 abdominal segments in a length of 37 mm. Another, less contracted one, about 4 mm. broad, has 16 pairs of branchiæ, 8 thoracic and 100 abdominal segments in a length of 75 mm. A smaller one, about 3.5 mm. broad, has 18 pairs of simple branchiæ, 8 thoracic and 50 abdominal segments in a length of about 20 mm.

Victoria, Vancouver Island, British Columbia, June 1, one poorly preserved specimen; New Metlakatla, Annette Island, June 4, three very young specimens; Yakutat, June 19, numerous specimens.

SCHIZOBRANCHIA NOBILIS sp. nov.

Pl. xxiv, fig. 3; Pl. xxviii, fig. 7; Pl. xxxiii, fig. 22; Pl. xxxv, figs. 1, 3-6, 8, 10, 11, 23.

*Type locality.* — Orca, Prince William Sound.

This species often has the whole body pervaded with pink or light wine color, and is larger than the preceding (*S. insignis*), with longer (about 23 mm.), more flexible, and more numerous branchiæ, there being about 26 in the outer series in each lobe, but similarly divided, the longest 4 times; the pinnæ are less crowded, forming more tapered ends.

Eyes numerous, varying in size and arrangement, sometimes with a diagonal line of pigment.

Many of the specimens are without posterior portions. The largest has 72 segments in a length of about 165 mm., or 6.5 inches. It is about 8 mm. broad at base of collar, and the 8 thoracic segments measure about 15 mm. along setæ. Two specimens "killed in formalin" are much contracted, and vary in breadth at base of thorax from 10 to 12 mm. The anterior fascicles of setæ form very oblique series, and on one specimen number 9 in a length of 15 mm.; on the other there are 8 in a length of 12.5 mm. Both have lost posterior portions, one having 60 segments in a length of 72 mm., the other 80 segments in 98 mm. In one the branchiæ, which number about 22 in each lobe, are beautifully expanded, the longest measuring about 30 mm. They are stout, unequal at base, and not regularly dichotomously divided, some having 4 and 5 divisions, so that some of the tips are double and some single, and may number 26 on a single branchia. Young specimens common at Dutch Harbor, Unalaska Island, about 3 mm. broad and from 25 to 75 mm. long, have from 6 to 8 thoracic segments, 12 to 16 pairs of branchiæ, the longest divided 2 or 3 times; occasionally one has 3 primary or basal divisions. A single specimen from Virgin Bay, Prince William Sound, differs from these in having 10 thoracic segments; on one side two of them have two fascicles of setæ and two tori. A few specimens contain eggs.

Orca, Prince William Sound, June 25-26, several specimens; Virgin Bay, Prince William Sound, June 27, one immature specimen; Dutch Harbor, Unalaska Island, July 8 and 17, many young.

## SCHIZOBRANCHIA CONCINNA sp. nov.

Pl. xxiii, figs. 2, 3; Pl. xxviii, fig. 2; Pl. xxxiv, figs. 15, 17, 18;  
Pl. xxxv, figs. 17, 24.

*Type locality*. — Orca, Prince William Sound.

At Orca, with the preceding species (*S. nobilis*), the anterior portion of a single specimen was found, which is remarkable for its slender rounded form and long, unequal, very slender branchiæ with their numerous terminal branches, about 22 in each lobe, the long ones about 30 mm. in length, often regularly forked 6 times, so that one might have as many as 64 tips. The pinnæ are long and very slender. The eyes are numerous and very conspicuous, though varying in size, often with a diagonal line of pigment.

There are about 16 segments in a length of about 33 mm., 8 of which belong to the thorax, which is about 7.5 mm. in breadth at base of collar and 13 mm. in length along setæ.

Young, varying in size from 11 to over 50 mm. in length and .5 to 3 mm. in breadth, have 5 to 14 pairs of branchiæ, 6 to 8 thoracic and from 40 to over 60 abdominal segments. They differ from *S. dubia* in having both body and branchiæ tinged with delicate pink or wine color and the setæ and avicular uncini larger and more numerous.

## SCHIZOBRANCHIA DUBIA sp. nov.

Pl. xxviii, fig. 1; Pl. xxix, fig. 1; Pl. xxxiii, fig. 7; Pl. xxxvi, figs. 1, 2, 3,  
17, 18, 19, 20; Pl. xxxvii, fig. 28.

*Type locality*. — Orca, Prince William Sound.

This species bears a superficial resemblance to *Pseudopotamilla reniformis* (Müller) and *P. oculifera* Leidy, but differs in having some of the branchiæ forked.

The slender tubes are found in closely crowded masses.

The animals in preservation show but a slight tinge of brown on the base of the branchiæ, which are relatively long and slender, with long graceful pinnæ forming broadly rounded ends. Eyes very conspicuous.

There is great irregularity in the development of the 40 or 50 specimens examined. Among those of the same size, the larger number have 6 and 7 thoracic segments on opposite sides, a few have 8, and one has 9; in those differing in size this inconstancy is still more marked. The smallest specimen, about 6 mm. long and 1 mm. broad, has 8 thoracic and 25 abdominal segments, 5 pairs of branchiæ, the dorsal ones forked; another, about 7 mm. long, has 8 thoracic and about 50 abdominal segments, 7 pairs of branchiæ; another, 15 mm.

long, has 6 and 7 thoracic and 50 abdominal segments and 8 pairs of branchiæ; among the largest specimens, 67 mm. long and 2.5 mm. broad, one has 7 thoracic and 115 abdominal segments and 14 pairs of branchiæ, and another has 8 thoracic segments and 15 pairs of branchiæ. There is also great diversity in the number of branchiæ which become forked.

The short tori and small fascicles of setæ forming straight series along the sides of the body, and the inferior spatulate setæ usually arranged in two parallel rows, appear to be constant in character.

Numerous specimens of a similar slender form collected at Dutch Harbor, Unalaska Island, differ in their relatively shorter, stouter, more divided branchiæ and in the greater number and size of their setæ and avicular uncini, which agree in form with those of *S. nobilis*.

### SCHIZOBRANCHIA AFFINIS sp. nov.

Pl. XXXIII, figs. 9, 11, 17, 23; Pl. XXXV, fig. 9.

*Type locality*. — Popof Island.

Two small crimson or wine-colored specimens appear to have little affinity with those of similar size belonging to other species. They are immature, as only one has the longest dorsal branchiæ forked; and as they are said to have been dredged, they are probably the young of some shallow-water form.

They are about 3 mm. in breadth, and have from 13 to 16 pairs of branchiæ about 7 mm. in length, which have long, rather stout, regularly developed pinnæ and a few conspicuous eyes. In both specimens posterior segments are wanting. One has 9 thoracic and 35 abdominal segments in a length of 27 mm., and the other has 8 thoracic and 20 abdominal segments, with well-developed eggs showing along their tori, in a length of 28 mm.

### Genus *Eudistylia* nov.

Type, *Eudistylia gigantea* sp. nov.

Like *Distylia* of Quatrefages (1865), this genus has the branchial lobes equal and spirally coiled, forming more or less elongated, permanent spires, differing in this character from typical *Sabella* and other genera which have the branchial lobes attached but a portion of their length, the more or less prolonged ventral portion being free and spirally twisted or involute in retraction, flaring in expansion (Pl. XXVI, fig. 2). Dorsal ends protected or stiffened by a conspicuous, usually white, thin edge.



Branchiæ numerous, usually simple, rarely divided, generally arranged in a single series, sometimes irregularly biserial, plumose, with a stout, gradually tapered, three-sided stem or rachis, rounded on the back, without appendages, flattened and slightly grooved along the inner surface, with thin membranous edges along the two angles, especially posteriorly, outside of which the long slender pinnæ arise. These decrease in length, more or less abruptly, near the end, leaving a short tapered tip. Groups of from 2 to 6 long delicate cilia, arranged in alternating longitudinal rows, are found on the surface of the pinnæ, under a high power.

Eyes usually present, irregularly arranged on one or both sides of the back of some of the rachises.

Collar four-lobed, meeting on the back, but little developed dorsally, arching more or less abruptly from dorso-lateral notches and continuing obliquely in a more or less undulating curve to small ventral ends.

A thin, wide, ruffled membrane extends inward from the ventral fissure along the base of the branchial lobes to the summit of each spire. Next the mouth are two large, irregular, leaf-like tentacles.

Body more or less compressed dorso-ventrally, gradually tapered to the pointed posterior end. Dorsal furrow very conspicuous anteriorly.

Fascicles of setæ, forming more or less oblique series on the thorax, of two forms: superior ones crescent-shaped, inferior ones laterally elongated, protected by a conspicuous auriform membrane. On the abdomen they are laterally elliptical.

Superior setæ comparatively few, with narrow lanceolate ends. Inferior setæ more numerous, of two forms, those of the first fascicle at the base of the collar with broader ends, those of the other fascicles, in 6 to 8 parallel rows, with spatulate ends. Setæ on the abdomen somewhat similar to the inferior ones of the collar fascicle, but longer and bent at the base of the blade. Two forms in the thoracic tori — avicular hooks (uncini) and pennoned setæ; avicular hooks only in the abdominal tori.

This genus is readily distinguished from *Distylia* by the *spatulate* inferior thoracic setæ.

#### EUDISTYLIA GIGANTEA sp. nov.

Pl. XXI, figs. 1, 2; Pl. XXII, figs. 4, a, c, d; Pl. XXIII, fig. 1; Pl. XXV, fig. 4; Pl. XXXII, figs. 1-8, 10-14, 16, 17, 21, 23-26; Pl. XXXIV, fig. 23.

*Type locality*. — Orca, Prince William Sound.

Color in formalin, yellow, tinged with brown, the branchiæ with three conspicuous bands of dark maroon or wine color. Small speci-



mens are much paler. Number of segments about 340, of which 8 belong to the thoracic region. They are very short on the abdomen, so that the tori are closely crowded. Branchial lobes forming well-separated spires of about  $2\frac{1}{2}$  turns, measuring about 16 mm. in height, without branchiæ.

Branchiæ long and flexible, the longest from 33.5 to 36.5 mm. in length in different specimens, numbering 125 to 135 in each lobe, and usually arranged in a single series; occasionally one occurs which has an additional one in front of it; one is also sometimes divided.

Eyes of good size, varying in number on different specimens and also in number and relative position on the same specimen.

Collar increasing abruptly in height from the wide angular lateral notches, slanting obliquely forward at a considerable angle, with slightly undulating margin and ending in two prominent angular processes on either side of the median ventral fissure.

Dorsal furrow very deep on the first few segments, turns to the right at the seventh segment, passes diagonally across the eighth segment to the ventral region, then diagonally across the first abdominal segment, turning downward into the ventral groove at the second segment.

Length of largest specimen 12 inches, breadth at end of thorax about 17 mm.; length of thorax along setæ about 13 mm., varying in different specimens from 11 to 15 mm. Another perfect specimen is 9.75 inches long and about 15 mm. wide.

Tube solitary, more or less bent, of a tough brownish chitinous substance, the rough surface usually covered along the exposed portion with sponges, ascidians, hydroids, seaweeds, etc.

Yakutat, June 22, two small specimens; Orca, Prince William Sound, June 25, ten large specimens; Virgin Bay, Prince William Sound, June 26, two small specimens.

Some of the specimens are abnormally developed. In the one figured, where an injury has been repaired, the symmetry in the arrangement and form of the thoracic setæ is interrupted, on one side between the sixth and seventh segments and on the other between the seventh and eighth. The additional one has no slender lanceolate superior setæ, but a somewhat elliptical fascicle of spatulate setæ, like the inferior ones; no torus, but an elliptical fascicle of setæ similar to those on the abdomen. Another, which also shows repairs of injuries, has 10 thoracic segments and smaller branchial lobes forming spires of about  $1\frac{1}{2}$  turns, with but 70 to 80 shorter (about 27 mm.) branchiæ arranged mostly in a double series, sometimes branched, rarely more than once. The avicular hooks also vary somewhat in form.

In some, eggs are seen through the integument along the abdominal tori.

A number of parasitic nematode worms were taken from the entire length of one specimen which was dissected. They were twisted about the spirally coiled intestine, filling the cavity on the sides of the segments.

### EUDISTYLIA PLUMOSA sp. nov.

Pl. XXI, figs. 3, 4; Pl. XXII, fig. 4, *b*; Pl. XXXII, figs. 9, 15, 18, 19, 20, 22.

*Type locality*. — Sitka.

Color in formalin, light brown, the branchiæ banded with delicate pink. The specimen is imperfect, there being but about 60 segments, of which 8 belong to the thoracic region. On the abdomen they are about twice as long as in the other related species, and well rounded.

Branchial lobes forming spires of 3 full turns measuring in height about 13 mm. without the branchiæ, which are beautifully plumose, long (about 22 mm.), very graceful, rarely divided, numbering about 135 in each lobe, arranged in a single series.

Eyes small, few, scattered, being present on but a few of the rachises.

Collar with very small dorsal lobes, increasing abruptly in height from small lateral notches, arching upward and forward in a regular curve to the conspicuous ventral ends.

Dorsal furrow very deep on the first three segments, turns to the right, passes diagonally across the eighth segment to the ventral region, curves around the fascicle of setæ of the first abdominal segment, and merges into the ventral groove on the second.

Length 4.5 inches; breadth at the end of thorax about 12 mm.; length of thorax along setæ about 13.5 mm.

Sitka, one imperfect specimen with a tough, semitransparent, chitinous tube.

This species can be readily identified by its rounded, little-tapered form, long and rounded segments, high collar, and very graceful and plume-like branchiæ.

### EUDISTYLIA ABBREVIATA sp. nov.

Pl. XXIV, fig. 4; Pl. XXXIII, figs. 1, 2, 10, 18, 75; Pl. XXXIV, figs. 13, 16.

*Type locality*. — Yakutat.

Although similar in coloring to *E. gigantea*, this species is easily recognized by the comparatively short, stout branchiæ. Medium-sized specimens (Pl. XXIV, fig. 4) show a striking resemblance in form to species of *Schizobranhia*.

Branchial lobes forming low spires of about 2 turns, with 70 or 80 short (about 16 mm.), stout, stiff, rarely divided branchiæ. Eyes very small and few in number.

Collar deep along the sides, curving abruptly and obliquely from the dorso-lateral notches to the rounded ventral ends.

Thoracic segments 8; abdominal segments in a medium-sized perfect specimen about 240; one very large mutilated one has over 325 segments.

The former is 6.5 inches, or 164 mm. long, 12 mm. along thoracic setæ, and 8.5 mm. broad at base of collar. Large ones are 12 mm. broad, and probably attain a length of 10 or 12 inches. One of the smallest specimens, with about 100 segments, is 30 mm. long and about 2.5 mm. broad.

Tubes covered with rather coarse black and variegated sand, which in turn is sometimes overspread by compound ascidians.

Yakutat, June 22, seven specimens; Ocean Cape, Yakutat, five specimens; Sitka, June 17, one specimen.

#### EUDISTYLIA TENELLA sp. nov.

Pl. xxii, figs. 2, 3; Pl. xxiii, figs. 4, 5; Pl. xxxiii, figs. 16, 19, 24; Pl. xxxiv, fig. 12; Pl. xxxv, fig. 22.

*Type locality*.—Victoria, Vancouver Island, British Columbia.

This species is at once distinguished by its very delicate branchiæ, the inner edges of their very slender rachises bordered by opaque yellowish crenulations from which the exceedingly fine cilia-like pinnae arise.

In the largest specimen the segments are irregularly developed on both the thorax and abdomen, especially along the middle portion, where some are divided on one side and others on the opposite side, the total number, however, being about the same (175); of these 10 on the left side and 11 on the right side belong to the thorax, the irregularity occurring on the first three segments. Three smaller specimens are, however, symmetrically developed and have but 8 thoracic segments.

Branchial lobes forming low spires of about 2 turns, bearing from 70 to 75 very slender branchiæ in an irregular double series, measuring about 16 mm. in length, usually of a very delicate pink color, sometimes with a broad band of deep wine color near their tips. Eyes none.

Collar with inconspicuous dorsal lobes, and wide shallow lateral notches, from which it slants obliquely forward to the small ventral ends.

Length of largest specimen about 4.5 inches; breadth at base of collar 6.5 mm.; length of thorax along setæ 15 mm. A more contracted one is 3.25 inches long, 8 mm. broad in middle of thorax.

Victoria, British Columbia, June 1, four specimens.

#### EUDISTYLIA POLYMORPHA (Johnson).

*Bispira polymorpha* JOHNSON, Proc. Boston Soc. Nat. Hist., vol. 29, p. 428, pl. 17, figs. 179-183; pl. 18, figs. 184, 185, 1901.

One young from Pacific Grove, California, and two well-grown specimens from Victoria, Vancouver Island, British Columbia, are readily identified by their conspicuous black eyes (pl. xxix, fig. 6).

Recorded by Johnson<sup>1</sup> from Pacific Grove, California, to Puget Sound, Washington.

#### EUDISTYLIA INTERMEDIA sp. nov.

pl. xxxiii, figs. 26, 28; pl. xxxiv, figs. 19, 20, 26; pl. xxxv, figs. 21, 29.

*Type locality*.—Pacific Grove, California.

Animal in formalin, pale cream color, with a brownish tinge on both the dorsal and ventral surfaces of the thorax, and a spot of dark bluish pigment showing through the integument at the side of each fascicle of setæ; a similar color showing also along the anterior abdominal tori; a broad band of brown and pinkish purple on the lower portion of the branchiæ, and a narrow, scarcely discernible pink one farther out.

Branchial lobes forming spires of about 3 turns, 13 mm. in height, each with 60 or more rather slender branchiæ, the longest about 18 mm. Pinnæ numerous and closely crowded. The thin dorsal ends of the lobes very noticeable. Eyes very small and scattered.

Collar but slightly developed dorsally, narrow on the sides, arching obliquely forward in an undulating curve, ending in small rounded ventral ends.

There are 8 thoracic and about 175 abdominal segments.

Length without branchiæ 144 mm.; breadth of thorax 10 mm.; length along setæ 11 mm.

This species is readily distinguished from *E. polymorpha* (Johnson) by its more numerous branchiæ, inconspicuous eyes, and form of the avicular uncini, which have much shorter, stouter necks, longer beaks, and are larger and less evenly rounded in front.

<sup>1</sup>Johnson's figure 179 on plate 17 is given as the 'ventral aspect'; it should be 'dorsal.' Also in his description on p. 428 'dorsal' should read 'ventral,' and *vice versa*.

## CHONE TERES sp. nov.

pl. xxx, fig. 1; pl. xxxvii, figs. 16-23.

*Type locality.* — Dutch Harbor, Unalaska Island.

A very slender species of a uniform yellowish tint, with very short branchiæ and very gradually tapered posterior end without ventral groove or sucker.

In the single specimen preserved in its tube, the segments, about 80, of which 8 belong to the anterior region, are not very clearly defined.

Branchiæ very short, about 12 in each lobe, longer in the right than in the left one, probably due to inequality in contraction, the longer twisted about the shorter, their rachises connected for the greater part of their length by a delicate membrane. They are furnished on their inner surface with numerous very delicate pinnæ, which end abruptly, leaving a thin, comparatively short, broad, abruptly tapered, naked, terminal portion. Eyes none.

Collar very deep, about  $2\frac{1}{2}$  times that of the first segment. Above there are several very long delicate filaments, either abnormal pinnæ or undeveloped branchiæ. There are two short, stout, dorsal tentacles.

Both dorsal and ventral grooves or furrows clearly defined; the dorsal one turning abruptly to the right passes between the eighth and ninth (last thoracic and first abdominal) segments diagonally across the latter below, and merges into the ventral one.

Fascicles of setæ in very straight series, as is usual in this genus. Superior fascicle very small, of but a few slender limbate setæ (pl. xxxvii, fig. 16) placed on the first segment at the base of the collar and on the succeeding segments above the elongated inferior fascicle of two rows of spatulate setæ (fig. 20), which is above and in front, or forward of and somewhat oblique to the short torus having a single row of hooked setæ (fig. 21). There are also found in the superior fascicles a few with abruptly bent shafts — bayonet setæ (fig. 18). On the abdomen the setæ are slender, limbate (fig. 17), in an elongated fascicle just in front of and below the very short torus of uncial plates (figs. 22, 23).

Length about 56 mm.; branchiæ about 8 mm.; anterior or thoracic region 9 mm.; breadth 2.5 mm.

Tube rough, thin, flexible, semitransparent, amber color, more or less tinted with brown, with very little adhering sand.

Although no mention of figures of odd 'bayonet' setæ have been noticed in descriptions of any of the known species of this genus, they are not regarded of sufficient importance to warrant any change in the

generic name, especially as they may be easily broken or not mounted in such a way as to show, and are consequently overlooked.

*Chone duneri* Malmgren (1867), from Spitzbergen, is a slender species, but is only half as long as the present one, with fewer, very long branchiæ having long, slender, naked terminal portions. *Chone infundibuliformis* Krøyer (1856), specimens of which from Greenland are before me, is a short stout species, with conspicuously marked segments and grooves, with very long branchiæ which number about 22 in each lobe.

### Genus *Metachone* nov.

Type, *Metachone mollis* sp. nov.

The setæ on the thorax of *M. mollis* are similar to those of *Dialychone acustica* Claparède (1870) from Naples, the type of the genus *Dialychone*, but the abdominal uncini are more nearly like those found in species of *Euchone*; while in *D. acustica* they more nearly resemble those of *Sabellides* Malmgren 1865 (Ampharetea), with the lowest tooth larger than the others.

### METACHONE MOLLIS sp. nov.

Pl. xxxv, figs. 19, 20, 28.

*Type locality*. — Pacific Grove, California.

A slender colorless specimen has lost a posterior portion, so that its exact generic position is uncertain. The setæ are similar to those of *Megachone aurantiaca* Johnson (1901), but there are additional inferior clavate ones on the thorax, which were not found in that species.

In the one branchial lobe preserved there are 17 branchiæ, with slender tapered tips and long delicate pinnæ, connected for the greater part of their length by a delicate web.

Collar deep, with dorsal incision only, *i. e.*, open on the back, with ends in contact.

Length of 8 thoracic and 10 abdominal segments 27 mm., breadth 2.5 mm.; length of branchiæ about 8 mm.; length of thorax about 10 mm.

The species described and figured by Verrill (1885) as *Sabella picta* is a *Metachone*.

Marczeller (1890) recorded *Euchone analis* (Krøyer) Malmgren from Bering Sea. It is possible that on further examination this may prove to be a distinct species, more nearly related to *M. mollis*.

## Family ERIOGRAPHIDIDÆ.

## MYXICOLA CONJUNCTA sp. nov.

Pl. XXVI, figs. 1, 4, a; Pl. XXXVIII, figs. 1-11.

*Type locality.* — Virgin Bay, Prince William Sound.

In general appearance this species closely resembles the *Myxicola steenstrupi* Kröyer from the Bay of Fundy.

Like that species its body is a pale yellow color, but the pinnæ of the branchiæ are of a decided brown, which shows through the pale rachises and web, giving a tinge of color to the whole. There is also sometimes a tinge of brown on the thorax.

The body gradually tapers, both forward and backward, from the end of the thorax, and differs considerably in length in full-grown specimens. The segments, which are well marked, biannular, vary in number from 100 to 115, of which 8 belong to the thorax.

As the branchiæ arise directly from the edge of the first segment, there are no smooth basal portions or lobes visible. There are 20 on each side, which are moderately long and tapered, their rachises connected by a membranous web for the greater part of their length, leaving comparatively long, slender, unadorned free ends; pinnæ numerous, very long and slender. Eyes none.

There is no collar, but the edge of the first segment is drawn inward on each side on a line with the fascicle of setæ, and below it is produced forward into a thin median triangular lobe, to protect the ventral branchial opening. A conspicuous membrane arises on each side of the dorsal groove or furrow, passes inward between the dorsal division of the branchiæ and around the mouth, forming two loops; there are no tentacles.

The dorsal furrow is conspicuous the entire length of the thorax, turns to the right, passes diagonally across the eighth and ninth (first abdominal) segments, and merges into the but faintly indicated ventral furrow.

The fascicles of setæ form straight series along the sides of the body, and are at first round and cushion-like in form, but decrease in size and become laterally compressed and somewhat elliptical in form on the succeeding segments.

On the first segment the setæ are of one form, long, with short, rather broad blades terminating in long slender capillary ends, and are arranged like needles around the edge of a cushion. The setæ of the next four segments are similar to these. On the sixth to eighth segments additional, often more slender, spear-shaped or hastate setæ



occur in the middle of the fascicle, which also have long slender capillary tips; these apparently become worn off, as the simple spear is often seen, and they often have more color than the other setæ. The hooked setæ are difficult to find, probably because easily broken, but have been seen on all but the first segment, never more than two together.

On the abdomen the setæ are spear-shaped, with long terminal filamentous ends. The uncial plates have a long slender primary tooth and a shorter closely appressed secondary one. They form a nearly complete circle around the body, passing posterior to the fascicles of setæ, interrupted only by a narrow ventral area.

Length of one of the largest specimens 120 mm.; breadth at base of thorax 7 mm., at first segment 5 mm.; length of branchiæ about 17 mm. A much more contracted specimen of 85 segments is about 55 mm. in length, 9 mm. in breadth at base of thorax, and 4.5 mm. at first segment, with the branchiæ 14 mm. in length. The smallest specimen, of about 50 segments and 10 pairs of branchiæ, is 15 mm. long, besides 7 mm., the length of the branchiæ.

Virgin Bay, Prince William Sound, June 27, sixteen specimens embedded in thick jelly.

#### MYXICOLA AFFINIS sp. nov.

Pl. xxxviii, figs. 17-20.

*Type locality.*—Pacific Grove, California.

A specimen filled with eggs, of a decided yellow color, with a greenish tinge to the branchiæ, especially the very long pinnæ, has 8 thoracic and 50 abdominal segments and 20 pairs of branchiæ with comparatively long, free, slender tapered tips.

It is very like specimens of *Myxicola steenstrupi* Krøyer (see Pl. xxxviii, figs. 13-16, 21, 22, 24) from the Bay of Fundy, but has the limbate setæ much broader, and the hooked thoracic setæ (numbering 14 on the last segment) stouter and much less curved.

Length 4.5 mm.; greatest breadth of thorax 5.5 mm., of first segment 4.5 mm.; length of branchiæ 12 mm., of free end 3 mm.

*Myxicola pacifica* Johnson (1901) is a larger species, with 9 thoracic segments and 14 pairs of very long (21 mm.) branchiæ.

#### MYXICOLA GLACIALIS sp. nov.

Pl. xxii, fig. 1; Pl. xxv, figs. 1, 2; Pl. xxvi, fig. 4, *b*; Pl. xxxviii, figs. 12, 23, 25-32.

*Type locality.*—Dutch Harbor, Unalaska Island.

This is a slender species, with the body of the usual cream color, the thoracic region and branchiæ colored with deep purple having a tinge



of brown. In life "white or yellowish with brown purple branchiæ."

Like all the species, there are the longer and shorter forms, but all taper gradually backward from the first segment, and have long, well-marked, biannular segments, which vary in number from 70 to 100, of which but 3 belong to the thorax.

There are 14 pairs of branchiæ, each with a rather short and broad terminal portion reaching beyond the web; the long, well-separated pinnæ are sometimes much curled and twisted.

The triangular ventral lobe of the first segment is well developed; the lateral puckerings are not always noticeable, and the distinction between the thoracic and abdominal regions is not clearly defined by a groove or furrow.

The hooked setæ, 4 in number, were found on the second and third segments and the uncial plates on the fourth (first abdominal) segment, and form a complete circle around the body commencing at about the twelfth segment, passing posterior to the fascicle of setæ.

The largest specimen is about 80 mm. long and 3.5 mm. broad at the first segment; branchiæ about 13 mm. long. The smallest specimen, of about 50 segments, with 9 pairs of branchiæ, is about 17 mm. long and 2.5 mm. broad, with the branchiæ 5 mm. long.

Dutch Harbor, Unalaska Island, July 8 and 17, thirty specimens embedded in much mucus under and between stones on shelly sand.

### Tribe SERPULIDES.

#### Family SERPULIDÆ.

Comparatively few authors have attempted any systematic work on this difficult group. Philippi in 1844 gave results of his study of the Mediterranean forms; Mörch in 1863 reviewed all the then known species and gave fine figures of the operculum of many of them; Levensen in 1883 added to the northern forms, but, as in the case of the Sabellides, Saint-Joseph in 1894 gave an extensive analytical table of the known genera, proposing many new ones, based on the different forms and arrangement of the setæ.

In studying many species, however, one soon finds it impossible to adopt all of his changes, especially in the genus *Spirorbis* (see p. 252), and that, although so many new names appear, there are still many interesting and peculiar forms which require to be separated under new genera; no attempt, however, has been made to find the correct generic relation of all the species hitherto published.

As similarly stated under the Sabellides, the following analytical table for the genera which are related to the genus *Serpula* is based

primarily on characters readily seen with the aid of a good pocket lens.

In instances, however, where the operculum has been lost other characters become most important, so that owing to the very small size of many of the animals higher powers are required.

Many forms which have simple tapered setæ in the collar fascicle are found to possess uncini and abdominal setæ which differ decidedly in form, so that many of the genera are based on these two characters. This is especially true of species hitherto referred to the genus *Vermilia* Lamarck 1818. As no figures appear to have been published of the setæ and uncini of the type species (*Vermilia triquetra* Lamarck), the only known character by which the genus is distinguished is the operculum with a calcareous plate, which was figured by Philippi in 1844. Langerhans in 1880, however, described and figured a species identified as *Vermilia polytrema* Philippi, which has not only the calcareous plate on the operculum but also two basal horny or chitinous spine-like processes, not unlike the figure given by Philippi 1844. The uncini have rather numerous long sharp teeth, the lowest much larger than the others and notched in the end, giving a bifid appearance; the abdominal setæ are trumpet-shaped, with a long slender end. The *Vermilia nigropileata* Ehlers 1901 has similar uncini, but the operculum is described as having a black horn-colored end without calcareous deposit. The *Spirobranchus occidentalis* McIntosh has a similar black horny cap on the operculum and similar uncini. Several species from Bermuda with a similar operculum are often found with the horny end covered by a thin layer of calcareous deposit which can be readily cleaned off. It is not improbable that the same condition existed in Lamarck's and Philippi's species and has been overlooked. "Operculum *testaceum* orbiculatum, simplex," was interpreted by Philippi as 'calcareous operculum.' The Bermuda species, however, as well as those described and figured by Marenzeller 1893 and Moore 1904 have uncini and abdominal setæ very unlike those given by Langerhans, McIntosh, and Ehlers, and also differ from each other. *Vermilia multivaricosa* (Mörch 1863) Marenzeller 1893, having the abdominal setæ strongly geniculate with, broad angular tapered blades, was made the type of the genus *Vermiliopsis* by Saint-Joseph 1894. The figures of *Vermilia infundibulum* Claparède 1870 and those of *Vermilia spirorbis* Langerhans 1883 do not appear to agree very closely with this species, although Marenzeller made them synonymous. *Vermilia multicristata* (Philippi 1844) Marenzeller 1893, having but slightly bent, narrower, regularly tapered abdominal setæ, as well as different uncini, is here referred to the new genus *Metavermilia*, as

type; and one of the Bermuda species (*P. bermudensis* sp. nov.) having nearly straight regularly tapered setæ similar to those on the thorax, with deeply serrate edges and still different uncini, is made the type of another new genus, *Paravermilia*. The thoracic setæ in all three forms are regularly tapered, differing only in their comparative length and breadth; the opercula are also alike in having a horny or chitinous end which varies greatly in form. In the Bermuda species it forms a high, irregularly bent or curved tapered cone made up of several unequal parts which fit on to each other, resembling a spiral shell.

The uncial plates in the numerous forms belonging to this family show great variability in form, are often very irregular in outline, but the opposite sides stand in definite relation to each other so that 'tetragonal,' 'rectangular,' 'rhomboid' and 'trapeziform' have been adopted for them in the following table.

#### ANALYTICAL TABLE FOR SERPULA AND RELATED GENERA.

- |   |     |
|---|-----|
| 1. With an operculum.....   | 2.  |
| 1'. Without an operculum (see p. 226).....  | 14. |
| 2. One or more entire branchiæ differentiated into or replaced by a peduncle bearing an operculum.. | 3.  |
| 2'. Tip only of one or more branchiæ differentiated into an operculum-like organ (see p. 226).....  | 11. |
| 3. Operculum furnished with a calcareous plate.....   | 4.  |
| 3'. Operculum furnished with a chitinous or horny plate (see p. 223).....                           | 8.  |
| 4. Collar setæ present.....   | 5.  |
| 4'. Collar setæ absent.   |     |

#### • (1) PLACOSTEGUS Philippi 1844.

Type, *P. tridentatus* (Fabricius 1779, as *Serpula*, + Gunnerus 1768, figure, as *Serpula triquetra*, + Philippi 1844, figure, as *P. crystallina*) Mörch 1863, as first species, also as *P. tricuspidatus*, + Levinsen 1883, figures, + Marenzeller 1893, figures. North Atlantic Ocean, in 20-200 fms.

Uncial plates rectangular in form, with very numerous fine appressed teeth, the lowest large and fang-like. Operculum with calcareous plate.

#### • (2) PLACOSTEGOPSIS Saint-Joseph 1894.

Type, *P. langerhansi* (Marenzeller 1893, as *Placostegus*, + Langerhans 1883, figures, as *Placostegus tricuspidatus*, non Sowerby) Saint-Joseph 1894. Madeira, Atlantic Ocean.

Uncini similar to those in *Spirorbis*. Operculum with a simple calcareous plate.

#### 5. Superior setæ not simple tapered blades..... 6.

#### 5'. Superior setæ simple tapered blades.

#### • (3) DASYNEMA Saint-Joseph 1894.

Type, *D. chrysogyrus* (Grube 1878, figures, as *Serpula*) Saint-Joseph 1894. Philippine Islands, Pacific Ocean.

Uncini somewhat similar to those in *Spirorbis* (?), "pectiniform with numerous teeth." No figure. Operculum with shallow calcareous cap.

- ~ (4) VERMILIA Lamarck 1818, + Philippi 1844, restricted.

Type, *V. triquetra* Lamarck 1818 (*non Serpula triquetra* Linné), + Philippi 1844, figure, + Mörch 1863, as *V. dinema*. Mediterranean Sea.

Uncial plates not known. Operculum with elongated, somewhat cylindrical calcareous cap, figured as not covering the entire end of the operculum, thus giving the appearance of basal processes.

- ✱ (5) POMATOCEROS Philippi 1844.

Type, *P. triquetra* (Linné 1767, as *Serpula*, + Leuckart 1849, as *P. tricuspis*, *non* Philippi 1844, figure) Mörch 1863, as first species, + Saint-Joseph 1894, figures.<sup>1</sup> North Sea, Atlantic Ocean.

Uncial plates trapeziform, with pointed teeth, the lowest one larger than the others. Operculum with calcareous plate bearing a cluster of yellowish spines (usually three). See Pl. XLIV, fig. 3.

- (6) GALEOLARIA Lamarck 1818.

Type, *G. cæspitosa* Lamarck 1818, + Mörch 1863, as first species. Australia, Pacific Ocean.

Uncini unknown. Operculum with tessellated calcareous cup bearing variable movable spines.

#### 6. Superior setæ variable in form.

- ~ (7) SPIRORBIS Daudin 1800 (see p. 236).

Type, *S. spirorbis* (Linné 1760, + Daudin 1800, as *S. borealis*) (see p. 262). North Sea on *Fucus*, Atlantic Ocean.

Uncial plates somewhat rectangular, with rather numerous appressed equal teeth. Operculum with the calcareous plate variable in form.

#### 6'. Superior setæ constant or uniform..... 7.

#### 7. Superior setæ with posterior fin-like expansion.

- ~ (8) FILOGRANULA Langerhans 1883.

Type, *F. gracilis* Langerhans 1883, figures. Madeira, Atlantic Ocean.

Uncial plates similar to those in *Spirorbis*. Operculum with calcareous concave cap.

#### 7'. Superior setæ geniculate, with numerous small spines at base of blade.

- ✱ (9) POMATOSTEGUS Schmarda 1861.

Type, *P. stellata* (Abildgaard 1789, figures, as *Terebella*) Schmarda 1861, as *P. macrosoma*, figures, + Mörch 1863, + Baird 1865, + Benedict 1886, figures. West Indies, Atlantic Ocean.

Uncial plates tetragonal, with numerous pointed teeth, the lowest one larger, blunt and more conspicuous than the others. Operculum consisting of a number of separate calcareo-chitinous or horny plates joined by a central axis in the form of a pyramid.

- 1 (10) SPIROBRANCHUS Blainville 1817. (*Cymospira* Savigny 1809, + Blainville 1828.)

Type, *S. giganteus* (Pallas 1766, figures, as *Serpula*, + Blainville 1828, figures, as *Cymospira*), Mörch 1863, figures, + Ehlers 1887, figures. West Indies, Atlantic Ocean.

<sup>1</sup> In the series of specimens from Denmark, in the Yale Museum, some of the opercula have apparently lost the spines, which are replaced by a conspicuous node of calcareous deposit. The collar setæ are small and few in number.

Uncial plates tetragonal, with somewhat irregular, pointed teeth, the lowest one larger than the others, often blunt, twisted. Operculum with a calcareous plate bearing a cluster of branching spines.

8. Collar setæ present..... 9.  
8'. Collar setæ absent.

\*(11) RHODOPSIS gen. nov. (see p. 179 and Addendum).

Type, *R. pusillus* sp. nov. Bermuda, Atlantic Ocean.

Uncial plates tetragonal, with appressed teeth, the lowest larger than the others. Operculum with a chitinous or horny disk covered with horny spines in the form of a rosette.

9. Superior setæ on collar not simple tapered blades..... 10.  
9'. Superior setæ on collar simple tapered blades.

\*(12) VERMILIOPSIS Saint-Joseph 1894.<sup>1</sup>

Type, *V. multivaricosa* (Mörch 1863, as *Vermilia*, + Marenzeller 1893, as *Vermilia*, figures) Saint-Joseph 1894, restricted. Mediterranean Sea.

Uncial plates tetragonal, with appressed rather blunt teeth, the lowest larger and more conspicuous than the others. Operculum with horny cap.

\*(13) PARAVERMILIA gen. nov. (see p. 221).

Type, *P. bermudensis* sp. nov. Bermuda, Atlantic Ocean.

Uncial plates somewhat rectangular, with appressed teeth, the lowest large and blunt. Operculum with horny cap often resembling a little spiral shell.

\*(14) METAVERMILIA gen. nov. (see p. 220).

Type, *M. multicristata* (Philippi 1844, figure, as *Vermilia*, + Langerhans 1883, as *Vermilia multicostata* and *Vermilia clavigera*, figures, + Marenzeller 1893, as *Vermilia*, figures). Mediterranean Sea.

Uncial plates trapeziform, with long slender teeth, the lowest longer than the others. Operculum with a conic horny cap.

\*(15) HYALOPOMATUS Marenzeller 1878.

Type, *H. clapedii* Marenzeller 1878, figures. Arctic Ocean, off Nova Zembla, in about 125 fms.

Uncial plates tetragonal, with numerous appressed teeth, the lowest very long and fang-like. Opercula membranous? bulb with central air-chamber. (The figure shows distinct cell structure.)

\*(16) DITRYPA Berkeley 1832-4.<sup>2</sup>

Type, *D. arietina* (Müller 1776) Berkeley 1832-4, + M. Sars 1835, figures, + Saint-Joseph, 1898. Shore of Norway, Atlantic Ocean.

Uncial plates somewhat similar to *Spirobranchus*. Operculum with flat horny plate ornamented with striae.

\*(17) JANITA Saint-Joseph 1894.

Type, *J. fimbriata* (Della Chiaji 1828, as *Serpula*, figures, + Philippi 1844, as *Placostegus*,<sup>3</sup> figure, + Mörch 1863, + Langerhans 1883, as

<sup>1</sup>*Vermilia agglutinata* Marenzeller 1893, figures, is a *Vermiliopsis*.

<sup>2</sup>Berkeley's species was *D. subulata* (figures) and Sars' species, *D. libera*.

<sup>3</sup>Philippi described the operculum as having a calcareous plate, which is figured as a simple disc, not at all like Langerhans' figure. Future study may prove the two forms to be distinct species.

*Omphalopoma spinosa*, figures, + Marenzeller 1893, as *Omphalopoma*, figures) Saint-Joseph 1894. Mediterranean Sea.

Uncial plates rhomboidal, with appressed teeth, the lowest long and blunt. Operculum with concave horny cap.

10. Superior setæ with posterior fin-like expansion.

1 (18) *OMPHALOPOMA* Mörch 1863.<sup>1</sup>

Type, *O. umbilicata* Mörch 1863. Philippine Islands, Pacific Ocean.

Uncini unknown. Operculum with a concave horny cap.

2 (19) *HYALOPOMATOPSIS* Saint-Joseph 1894.

Type, *H. marenzelleri* (Langerhans 1883, figures, as *Hyalopomatus*) Saint-Joseph 1894. Madeira, Atlantic Ocean.

Uncini somewhat similar to *Spirorbis*, the teeth longer. Operculum with a chitinous or horny cap.

3 (20) *CHITINOPOMA* Levinsen 1883.<sup>2</sup>

Type, *C. greenlandica* (Malmgren 1867, as *Hydroides*) Levinsen 1883, figures, as *C. fabricii*. Greenland, North Atlantic Ocean.

Uncial plates trapeziform, with appressed teeth, the lowest larger than the others. Operculum with concave horny plate.

4 (21) *OMPHALOPOMOPSIS* Saint-Joseph 1894.

Type, *O. langerhansi* (Marenzeller 1884, as *Omphalopoma*, figures) Saint-Joseph 1894. Japan, Pacific Ocean.

Uncial plates trapeziform, with comparatively few pointed teeth, the lowest large and blunt. Operculum with concave horny plate.

10'. Superior setæ geniculate, with conspicuous spines at base of blade.

5 (22) *SERPULA* Linné 1767, + Philippi 1844.

Type, *S. vermicularis* (Ellis 1755, figures, as *Tubus*) Linné 1767, + Saint-Joseph 1894, figures. North Atlantic Ocean.

Uncial plates tetragonal, with few unequal coarse serrations. Primary operculum funnel-shaped, with numerous radii forming serrations on margin; secondary operculum usually club-shaped, occasionally like primary one.

6 (23) *SCLEROSTYLA* Mörch 1863.

Type, *S. ctenactis* Mörch 1863. St. Thomas, West Indies, Atlantic Ocean.

Uncini like *Serpula*. Operculum with comparatively few radii forming a scalloped margin; intermediate between *Serpula* and *Crucigera*. It is described by Mörch as calcareous.

7 (24) *ZOPYRUS* Kinberg 1866.

Type, *Z. loveni* Kinberg 1866,<sup>3</sup> as first species. Straits of Magellan, Island of Bucket, Pacific Ocean.

Uncial plates unknown. Opercula funnel-shaped and club-shaped.

<sup>1</sup> Saint-Joseph (1894) restricted this genus to *O. cristata* Langerhans (1883), figures, from Madeira, which has a thin concave horny plate in the operculum and uncini somewhat similar to those in *Spirorbis*.

<sup>2</sup> *Vermilia serrula* Stimpson 1853, + Verrill 1885, figure, from Grand Manan, New Brunswick, appears to be synonymous with this species.

<sup>3</sup> As no figures of this species seem to have been published, very little definite knowledge is available by which to determine the correct position of the genus; Ehlers 1901 placed it next to *Serpula*.



• (25) *CRUCIGERA* Benedict 1886.

Type, *C. websteri* Benedict 1886, figures. Gulf of Mexico, Atlantic Ocean, in 26 fms.

Uncial plates similar to those in *Serpula*. Operculum with cup similar to that in *Sclerostyla*, but with conspicuous basal processes.

(26) *HYDROIDES* Gunnerus 1768.

Type, *H. norvegica* Gunnerus 1768, figures, + Mörch 1863, figures, + Marenzeller 1893, figures, + Saint-Joseph 1898. North Atlantic Ocean.

Uncini similar to those in *Serpula*. Operculum similar in form to *Serpula*, with a central crown of horn-colored spines, each with lateral processes.

(27) *EUPOMATUS* Philippi 1844.<sup>1</sup>

Type, *E. uncinatus* Philippi 1844, figure, + Quatrefages 1865, figures, + Ehlers 1887, figures. Mediterranean Sea.

Uncini similar to those in *Serpula*, with fewer teeth than type. Operculum similar in form to *Serpula*, with a central crown of horn-colored, simple, curved, regularly tapered spines without lateral processes.

(28) *EUCARPHUS* Mörch 1863.<sup>2</sup>

Type, *E. cumingii* Mörch 1863, figures. Philippine Islands, Pacific Ocean.

Uncini similar to those in *Serpula*. Operculum<sup>3</sup> similar to that of *Serpula*, with central crown of horn-colored spines the ends of which are blunt, with a lateral process on each side.

• (29) *SCHIZOCRASPEDON* gen. nov. (see p. 287).

Type, *S. furcifera* (Grube 1878, as *Hydroides*, figures). Philippine Islands, Pacific Ocean.

Uncini somewhat similar to those in *Eupomatus*. Operculum forming two deep funnels, one above the other, without radii, with the edge of each split into long, slender, divided processes; those on the upper one with small, dark spines on their inner proximal portion.

• (30) *GLOSSOPSIS* gen. nov. (see p. 287).

Type, *G. minax* (Grube 1878, as *Hydroides*, figures). Philippine Islands, Pacific Ocean.

Uncini similar to the preceding. Operculum a deep funnel without radii, the edge cut into broad deep points, each with a terminal knob; a long, rounded, tongue-like, curved process with fluke-like tip, bearing a

<sup>1</sup> *Polyphragma* Quatrefages 1865 included *Eupomatus* and *Hydroides*.

<sup>2</sup> *Phragmatopoma* Mörch 1863, type *P. caudata* (Kröyer) Mörch 1863, figures, has an operculum resembling that of *Sabellaria virgini* Kinberg 1866, + Ehlers 1901, figures (Hermellidæ), and is probably closely related to that genus. Kinberg (1866) refers three new species to the genus, which he places in his family Hermellæa.

<sup>3</sup> The *Eupomatus lunulifera* Claparède 1870, figures, has a similar operculum and should be referred to *Eucarpus*.

lateral palmate form of about 7 long unequal pointed lobes, arises from the center of the cup.

11. Operculum with a calcareous plate (see p. 221).

Superior setæ on collar simple tapered blades.

• (31) JOSEPHELLA Caullery and Mesnil 1896.

Type, *J. marenzelleri* Caullery and Mesnil 1896, figures. Cape de la Hogue, northern coast of France, English Channel.

Uncini similar to *Vermiliopsis*. Operculum with long conic calcareous plate.

11'. Operculum membranous or chitinous..... 12.

12. Superior setæ on collar not simple tapered blades..... 13.

12'. Superior setæ on collar simple tapered blades.

(32) APOMATUS Philippi 1844.

Type, *A. ampulliferus* Philippi 1844, + Marion and Bobretzki 1875, figures.<sup>1</sup> Mediterranean Sea.

Uncini similar to *Protula*. Operculum a membranous(?) sphere.

• (33) APOMATOPSIS Saint-Joseph 1894.

Type, *A. similis* (Marion and Bobretzki 1875, as *Apomatus*, figures, + Marion 1879, figures) Saint-Joseph 1894. Mediterranean Sea (Marseilles).

Uncini and operculum similar to preceding.

13. Superior setæ geniculate.

(34) PROTOPLACOSTEGUS gen. nov. (see p. 287).

Type, *P. mörchii* (McIntosh 1885, as *Placostegus*, figures).

Uncini somewhat similar to *Serpula*. Operculum with horny cap.

13'. Superior setæ with posterior fin-like expansion.

~(35) FILOGRANA Oken 1815, + Berkeley 1832.<sup>2</sup>

Type, *F. implexa* Berkeley 1827, as *Serpula*, figures, + Saint-Joseph 1894, figures. (See footnote 2.) North Atlantic Ocean, in 20 to 40 fms.

Uncini similar to *Vermiliopsis*. A spoon-shaped organ on one or more branchiæ.

14. Superior setæ on collar not simple tapered blades, i. e., with posterior fin-like expansion (see p. 221).

(36) SALMACINA Claparède 1870.<sup>2</sup>

Type, *S. incrustans* Claparède 1870, figures. Bay of Naples, Mediterranean Sea.

Uncini somewhat similar to *Serpula*.

<sup>1</sup> Saint-Joseph proposed to separate the four species (*A. ampulliferus* Philippi 1844, *A. enosimæ* Marenzeller 1885, *A. globifera* Theel 1879, and *A. similis* Marion and Bobretzki 1875) into two genera based on the difference in form of the abdominal setæ, under the names *Apomatus* and *Apomatopsis*, but unfortunately places the species for which the genus *Apomatus* was proposed, under the later name, thus, unless transposed, making the two synonymous.

<sup>2</sup> *Salmacina ædificatrix* Claparède 1870 (appendix) is figured as having the tips of the branchiæ regularly tapered. The spoon-shaped end figured by Saint-Joseph (1894) as belonging to *Salmacina dysteræ* Huxley (as *Protula*, 1855) is either an error in reference for *Filograna implexa*, or the species is erroneously referred to *Salmacina*.



(37) *PROTIS* Ehlers 1887.

Type, *P. simplex* Ehlers 1887, figures. West Indies, Atlantic Ocean, in 860 fms.

Uncini similar to *Eupomatus*.

14'. Superior setæ on collar simple tapered blades..... 15.

15. Branchial lobes not spiral.

(38) *PSYGMOBRANCHUS* Philippi 1844.<sup>1</sup>

Type, *P. protensus* (Gmelin) Claparède 1870, figures. Mediterranean Sea.

Uncini similar to *Protula*.

15'. Branchial lobes spiral.

(39) *PIRATESA* Templeton 1835.<sup>2</sup>

Type, *P. nigroannulata* Templeton 1835, figures, + Kinberg, 1866. Black River, Island of Mauritius, Indian Ocean.

Uncini unknown.

(40) *PROTULA* Risso 1826.

Type *P. rudolphi* Risso 1826, as first species. Mediterranean Sea at Nice in about 3 feet.

Uncial plates irregular in outline, with numerous very fine teeth on the face, the lowest one very long and fang-like.

(41) *PROTULOPSIS* Saint-Joseph 1894.<sup>3</sup>

Type, *P. intestinum* (Lamarck 1818, as *Protula*) Saint-Joseph 1894, figure. Seas of Europe (Triest and Naples).

Uncini unknown.

<sup>1</sup> *Psychmobranchus cæcus* Claparède 1870 has uncini with few coarse teeth like *Eupomatus*, and is probably referable to *Protis*, although Claparède suggested its resemblance to *Salmacina*. *Psychmobranchus multicostatus* Claparède 1870 has uncini more nearly like *Serpula*, so that it should be referred to *Salmacina*.

<sup>2</sup> *Anisomelus luteus* Templeton 1835, from the figures, shows characters placing it with the Terebellacea as designated by Quatrefages (1865), rather than with the Serpulacea as given by Mörch (1863). There are four pairs of branchiæ, very long and very short, below which, on the thorax, are 6 filaments similar to those found on *Trichobranchus glacialis* Malmgren 1865, figures.

<sup>3</sup> Saint-Joseph (1894) makes *Protula intestinum* Lamarck, an abdominal seta of which he figures, the type of a new subgenus, *Protulopsis*. There is, however, considerable uncertainty in regard to the other characters, as no figures have been found. Excellent figures are given by Fischli (1900) of his species *Protulopsis nigra-nucha*; the uncini are similar to *Hyalopomatopsis*.

## PROTULA ATYPHA sp. nov.

Pl. XXXVII, figs. 1, 2, 4.

*Type locality*.—Pacific Grove, California.

An imperfect animal without color, poorly preserved in a portion of a white, calcareous, irregularly bent tube.

There are but 12 segments back of the thorax, which is long, of 7 segments, all of the well-separated fascicles of setæ directed obliquely backward in nearly straight series, the wide membrane bordering it forming a rather deep irregular (mutilated) collar.

Branchial lobes of good size, elongated ventrally and involute, bearing numerous (about 30, besides a few rudimentary ventral ones) long, delicate (?), densely pinnate branchiæ in each lobe.

No operculum.

Mouth parts not determinable.

Setæ on the thorax of one form, slender, unequal (the shorter ones the broader), capillary, those on the collar fascicles not different from the others. Setæ on the abdomen in small fascicles and bent at the base of the moderately broad tapered blade (Pl. XXXVII, fig. 1).

Both thoracic and abdominal tori small, with the thin uncial plates (Pl. XXXVII, figs. 2, 4) of similar size and form, apparently smooth, with only a long pointed terminal tooth, serrations but faintly visible on the exposed surface even under a high objective.

Length of thorax 9 mm.; breadth about 3 mm.; length of longest branchia about 9 mm.

Pacific Grove, California, August, 1901, one specimen.

The thoracic membrane does not form a scalloped border along the sides, so conspicuous in *P. media* Stimpson from Grand Menan, New Brunswick, figured by Smith and Harger 1874 (see Pl. XLIV, fig. 7), and the setæ are much coarser, those of the latter being very slender; the (much narrower) uncial plates also have more distinct teeth.

On account of its long abdominal setæ, Saint-Joseph would doubtless refer this species to his new subgenus *Protulopsis*, in which the abdominal setæ are "oblique bayonets, plicate on the border," as in *P. intestinum* Lam. *Protula* as a subgenus is restricted for species having shorter 'sickle-shaped' abdominal setæ, as *P. tubularia* Montagu. The figures given by Benedict (1886) of the abdominal setæ of *P. diomedæ* and *P. alba* show little resemblance to the figure given by Saint-Joseph of that of *P. tubularia*, but all three and others are mentioned by him as belonging together.

The very small *Protula arctica* Hansen 1882 was referred to the genus *Protis* by Ehlers 1887 (type, *Protis simplex*). The uncial plates have but a few (6) coarse teeth, and the collar setæ have a distinct basal expansion or fin. There is no operculum.

### HYALOPOMATOPSIS OCCIDENTALIS sp. nov.

Pl. XL, figs. 3, 22; Pl. XLIV, figs. 2, 4, 8, 9.

*Type locality*. — Virgin Bay, Prince William Sound.

Small, thick, white, calcareous, angular, more or less curved tubes, with a prominent median keel, were attached to tubes of *Serpula splendens*. They strongly resemble the figure of the tube of *Chitinopoma greenlandica* (Mörch)<sup>1</sup> given by Levinsen in 1883 as *C. fabricii* (*Serpula triquetra* Fabricius non Linné).

The colorless animal also has a long, slender, rounded form similar to Levinsen's figure.

The branchial lobes are small, not prolonged ventrally, nor involute, and bear 6 pairs of long branchiæ, their rachises broad at base and furnished on their inner surfaces with long, graduated, ciliated pinnæ not extending to the end but leaving a long, unadorned, terminal portion; an additional smaller undeveloped branchia is on the end of the lobe opposite the one bearing the operculum. This is a small, elongated, semitransparent bulb on a very long, slender peduncle, often covered on the end with delicate algæ (Pl. XLIV, fig. 8), in the adult specimens usually showing an inner sphere (air bubble?).

No thoracic membrane.

Collar very deep, with deep lateral clefts.

There are about 60 segments, of which 7 belong to the thorax, where the fascicles of setæ form straight series and the tori are short.

<sup>1</sup> Mörch in 1863 referred the *Serpula triquetra* of Fabricius 1780 to *Hydroides norvegica* as var. *grönlandica*, which Malmgren in 1867 separated as a distinct species, referred to *Hydroides* with doubt, so that Levinsen's name *fabricii* is superfluous.

Specimens attached to stones from Greenland and to the tubes of *Nothria conchylega* from 32 fathoms off the New England coast are in the Yale University Museum, and may prove to be the same as those on the same host from Greenland identified by Moore (1902) as *Serpula* sp.; these could not be compared. The operculum (Pl. XXXVII, figs. 3, 9) is covered by a thin chitinous cup-like plate, and has not the bulb-like form of the western species. When stained and mounted in glycerine, a central chamber with connecting peduncle-canal was distinctly revealed, which differs from that in the opercula of *Spirorbis* in having three distinct parts, those above and below the central chamber or cavity being filled with animal matter. See also Pl. XL, fig. 31.

Setæ of the collar fascicle of two forms, long slender limbate and others with broad spinous basal fin (Pl. XL, fig 22). Other fascicles with shorter and broader limbate setæ. No capillary ones, as in *Spirorbis*.

Uncini with numerous teeth, the lowest one larger than the others.

Abdominal setæ small, trumpet-shaped, with a long tapered end.

Total length of largest specimens between 15 and 20 mm.; breadth about .5 mm. Smallest specimen about 5 mm.

Virgin Bay, Prince William Sound, June 27, eight specimens.

### SERPULA SPLENDENS sp. nov.

Pl. XXVI, fig. 3; Pl. XXIX, fig. 2; Pl. XXX, figs. 2, 3; Pl. XXXIII, fig. 31;  
Pl. XXXV, fig. 18; Pl. XXXVII, fig. 31; Pl. XXXIX, fig. 33.

*Type locality*.—Prince William Sound, at Orca and Virgin Bay.

Color in formalin yellowish, with the branchiæ and operculum variously banded and mottled with deep crimson, which in life is a 'brilliant red.'

Thoracic membrane with a very wide margin overlapping on the back and forming a very deep rolling collar with a median ventral and two lateral incisions.

Branchial lobes with comparatively small basal attachment, arching obliquely forward, curving inward ventrally, thickest below and strengthened by a conspicuous tapered median rib, and in front, at the end, by a large rib reaching backward inside the collar. Between these end ribs and attached to them is a broad, gradually widening, muscular band curving inward between the bases of the lobes, forming a trumpet-shaped process over the mouth; above this is a thin, somewhat ruffled membrane, which extends out on each side around and inside the lobes, attached to their bases; extending forward and inward from the dorsal furrow is a tongue-shaped process, free at the end, having a granular surface, which completely covers the end of the trumpet.

Branchiæ short, between 45 and 50 pairs, their tapered rachises rounded outwardly, with short filamentose tips, the two inner edges bearing long well-separated pinnæ; a few of the extreme ventral branchiæ extend around the end of the lobe and backward or inward along its edge.

Opercula two; the primary one thin, large, deep funnel-shaped, with numerous delicate branching radii, forming a finely serrate (between 127 and 150 serrations) margin, the inner surface often with minute scattered tubercles; base globular, without processes, attached

by a stout peduncle to the dorsal end of either branchial lobe; secondary one, when present, somewhat club-shaped, attached to the opposite lobe by a more slender, shorter stem.

Number of segments about 320, of which 7 belong to the thorax, on which the fascicles of setæ form very oblique series; abdominal segments short, the lines of uncini closely crowded.

Fascicles of setæ on the thorax tubular in form; the first well forward on the collar, smaller than the succeeding ones, and directed forward; the others, directed obliquely backward, vary slightly in size, become flattened and laterally elongated. The setæ are of two forms; on the collar slender capillary superior ones and stout bayonet-shaped inferior ones, spinous at the base of the blade (Pl. XXXIII, fig. 31), on the other segments capillary only; uncial plates with 6 to 7 long teeth, apparently in two rows (Pl. XXXVII, fig. 31). On the abdomen fascicles of the characteristic short flaring-ended setæ, and on the caudal region other small fascicles of very long, slender, stiff spines; uncial plates similar to but smaller than those on the thorax, becoming thicker, with more rows of teeth in the caudal tori (Pl. XXXIX, fig. 33).

In very young animals taken from their tubes, stained, and mounted, the operculum appears club-shaped; the rudimentary branchiæ resemble flattened strips of membrane with long unequal filamentose ends, and are covered by the collar; no membrane appears along the sides of the thorax; this, however, may be due to the position in mounting. There are about 50 rows of uncini on the abdomen, and 7 fascicles of setæ on the thorax; the setæ themselves are similar to those in the adult.

A perfect animal taken from its tube is 53 mm. long besides the branchiæ, which are about 8 mm., 7 mm. broad on the thorax, and 5.5 mm. on the abdomen. A larger imperfect one is 8.5 mm. broad on the thorax and 7 mm. on the abdomen. Diameter of operculum 5 to 7 mm. Another specimen, having about 190 segments, 30 pairs of branchiæ, and one operculum, is about 35 mm. long and 5 mm. broad on the abdomen.

Their tubes are thick, white, calcareous, variously twisted, more or less free, the surface of attachment flattened, the exposed surface often roughened by the small tubes of their own young, and also by species of *Spirorbis* and *Hyalopomatopsis*.

Prince William Sound, at Orca, June 25 and 26, two specimens; at Virgin Bay, June 27, ten specimens.

*Serpula jukesii* Grube 1877 (*non* Baird 1865) closely resembles this species.

The *Serpula columbiana* abundant in Puget Sound and extending southward along the California coast to Golden Gate is described by Johnson (1901) as having more numerous branchiæ (54 in each lobe), fewer serrations (100) on the margin of the operculum, and but 250 abdominal segments in a length of 55 mm., with a breadth of 7 mm. on the thorax.

Specimens collected by Dr. Coe in August, 1901, on the California coast are supposed to be immature examples of this species. They are without color in formalin, except one, which has two pink spots at the base of the trumpet-shaped process, but when first received one showed both red and orange bands on the branchiæ. The larger has 20 pairs of well-developed branchiæ, besides a few small ventral ones having very short pinnæ, and the operculum has 110 serrations on its margin. An example of the Alaska species of similar size has 35 pairs of branchiæ and 127 serrations on the margin of the operculum.

#### Genus *Crucigera* Benedict 1886.

Type, *Crucigera websteri* Benedict.<sup>1</sup>

The very small type species of this genus, a cotype specimen of which, from 26 fathoms in the Gulf of Mexico, has been sent from Washington, has four 'digital processes' at the base of the operculum, the axis of which is continuous with that of its peduncle. The Alaskan species, however, have but 3, 2 of them combining, forming a large, rounded, bilobed process, to which the abruptly contracted distal end of the peduncle is so attached that its axis is not continuous with that of the operculum. Benedict describes the texture as 'calcareo-cartilaginous,' but the operculum of the northern species, after soaking in potash solution, retains its form as a thin, transparent, chitinous shell. The tube is ornamented on one side by three conspicuous lamellar-like longitudinal carinæ, and on the opposite side by faintly indicated ridges. The thicker tubes of the northern forms show no indication of such ornamentation.

The operculum of *Serpula zelandica* Baird (1865), as shown in the figure, has similar coarse, blunt serrations on the margin, but no processes at its base, thus representing a transition between typical *Serpula* and *Crucigera*, and therefore referable to *Sclerostyla* Mörch 1863.

<sup>1</sup> Proc. U. S. Nat. Mus., ix, p. 550, pl. xx1, figs. 24, 25; pl. xxii, figs. 26-30, 1886.

## CRUCIGERA ZYGOPHORA (Johnson).

Pl. xxix, fig. 5; Pl. xxxi, fig. 2; Pl. xxxiii, fig. 3; Pl. xxxix, figs. 8, 12, 13, 15, 17, 20.

*Serpula zygophora* JOHNSON, Proc. Boston Soc. Nat. Hist., vol. 29, p. 433, pl. 19, figs. 205, 208, 1901.

*Type locality*. — Puget Sound.

Color, salmon or yellow, with the branchiæ irregularly banded with deep crimson, the operculum variously mottled with the same color, sometimes flecked on its outer surface with minute white specks.

The branchial lobes are characteristic of the Serpulas, each with about 30 branchiæ, having long, slender, tapered rachises, with very long (over 6 mm.) filamentose ends and moderately long delicate pinnæ.

Thoracic membrane with a wide free margin extending forward as an exceedingly deep collar, the ventral lobes of which often roll backward, nearly or quite covering the thorax.

Segments numerous, 115 or more; 6 on the thorax below the collar; those on the abdomen often marked only by the lines of uncini.

Often two opercula; the primary one bell-shaped, thick, shallow, sometimes so thick as to become flat on top, with 28 to 30 radii forming a bluntly scalloped margin; at its base are 3 conspicuous unequal processes, attached by a long peduncle to the base of one of the branchial lobes at its outer dorsal end; the secondary one, which is more or less club-shaped, without basal processes is, when present, attached by a shorter peduncle to the opposite lobe.

Length 50 to 80 mm.; breadth about 3 mm.; branchiæ about 15 mm.; diameter of operculum 4 mm.

One imperfect specimen is recorded by Johnson from Puget Sound, 1901; Sitka, June 15, common; Orca and Virgin Bay, Prince William Sound, June 25 and 27, very common.

Tube thick, calcareous, attached to fragments of shells in variously twisted masses, the free anterior end with a flaring margin.

## CRUCIGERA FORMOSA sp. nov.

Pl. xxviii, figs. 3, 4; Pl. xxxi, fig. 1; Pl. xxxiii, fig. 4; Pl. xxxix, figs. 6, 7, 10, 11, 14.

*Type locality*. — Dutch Harbor, Unalaska Island.

This species differs from the preceding in having shorter branchiæ, their rachises with short terminal filaments, sometimes wanting; yellowish in preservative but a 'brilliant red' in life.



The operculum has the basal processes nearly equal, smaller and somewhat tapered, and the distal end of the peduncle but slightly contracted. A delicate alga, a species of *Ectocarpus*, completely covers the anterior end. There is no secondary operculum on the type; a specimen from Wrangel, however, has two fully developed ones, to only one of which the *Ectocarpus* has become attached.

Length about 60 mm.; branchiæ about 6 mm.; breadth of abdomen 3 mm.; of thorax 4 mm.; diameter of operculum 3 mm.

Tube thick, calcareous, but slightly twisted.

Wrangel, June 5, one specimen; Dutch Harbor, July 8, one specimen. Said to be very common.

### CRUCIGERA IRREGULARIS sp. nov.

Pl. xxv, fig. 5; Pl. xxix, fig. 4; Pl. xxxiii, fig. 13; Pl. xxxix, figs. 1-5.

*Type locality*. — Juneau.

Color pinkish, the branchiæ and operculum banded and mottled with bright crimson.

This species differs from the two preceding ones in having longer branchiæ, their rachises with comparatively short terminal filaments; but especially in its operculum, which is irregular in form, laterally elongated, with about 32 broad radii, which form a thick scalloped edge, which rolls over along the longer and deeper portion. Only one large, broadly rounded, somewhat bilobed process is developed at one side of the base, to which the abruptly contracted distal end of the long stout peduncle is attached; secondary operculum very slender, club-shaped.

Length about 48 mm. from base of branchial lobes; breadth of thorax 4 mm.; longer diameter of operculum 4.5 mm.

Tube thick, calcareous, solitary, attached to a shell.

Juneau, July 6, one specimen.

### EUPOMATUS GRACILIS sp. nov.

Pl. xxvii, fig. 9; Pl. xxxiv, fig. 25; Pl. xxxvii, figs. 26, 27.

*Type locality*. — Pacific Grove, California.

Branchial lobes similar to those of *Serpula*, but not so prolonged ventrally, turning inward but little, the branchiæ (18 in each lobe) not extending backward along the end of the lobe, as in *Serpula*.

Operculum deep funnel-shaped, tapering regularly into its peduncle without basal enlargement or processes, with comparatively few regular radii forming deep sharp serrations (about 35) on the margin, and



bearing on its upper surface a central crown of 10 or 11 long, tapered, upward-curving, simple, horn-colored spines characteristic of *Eupomatus uncinatus* Philippi (1844) figured by Ehlers 1887; secondary operculum small, club-shaped, on a very short stem. One specimen has only a central horn-colored ring, the crown of spines having been lost, and the margin has apparently been injured on one side, where the serrations have grown together, forming an angulation.

Thoracic segments 7; abdominal segments over 70 in the largest example, which has lost a posterior portion.

A very wide membrane borders the thorax, forming a very deep collar with lateral incisions or clefts but with no median one, the ventral edge being entire; there is, however, a conspicuous oval opening considerably within the margin.

Sctæ similar to those in *Serpula*.

Length of thorax 3.5 mm.; breadth 3 mm.; length of longest branchia 5.5 mm.; diameter of operculum 2.5 mm.

Pacific Grove, California, August, 1901, three specimens.

The tubes are solitary, variously twisted, and attached for the greater part of, if not their entire length. The surface, roughened by growth lines, is often rust colored, covered with bryozoa and other animals.

*Hydroides protulicola* Benedict (1886), specimens of which are in the Yale Museum, is a typical *Eupomatus*, as is undoubtedly *H. spongicola* Benedict, judging from the figures. *Serpula dianthus* Verrill (1874) is also an *Eupomatus*. In *Hydroides* (type, *H. norvegica* Gunnerus) the spines forming the crown on the operculum have conspicuous lateral processes or secondary spines.

#### EUPOMATUS HUMILIS sp. nov.

Pl. xxxix, figs. 39, 40; Pl. XLIV, fig. 22.

*Type locality*. — Guaymas, Mexico.

A small (probably immature), thin, very slender, round tube, forming one long irregular loop, is attached its entire length to the side of a small coral.

The five branchiæ are long, stout, with few pinnae, the very small characteristic operculum on its very slender peduncle reaching above them. The operculum is colorless, with coarsely serrate margin, formed by about 10 long, broad points, crown of 8 long, simple, characteristic spines, each with a basal spinule on its inner surface.

Number of segments unknown, only the anterior portion having been found. Collar setæ few in number, the superior ones with 4

basal spines and slender, delicately serrate blade; setæ in the other fascicles slender blades. Uncini very small, with few sharp teeth.

SPIROBRANCHUS INCRASSATUS (Krøyer) Mörch.

Pl. xxxiv, fig. 24; Pl. xxxvii, figs. 25, 34.

*Spirobranchus incrassatus* MÖRCH, Rev. crit. Serpulidarum, Natur. Tidss., I, p. 405, pl. xi, figs. 21-23, 1863. — EHRLER, Blake Annelids, p. 294, taf. 57, f. 16; taf. 58, f. 1-5, 1887.

*Type locality.* — West coast of United States of Colombia.

A valve of *Margaritifera* sp., from the Gulf of California, in the Yale Museum is covered with a mass of the tubes of this species. They are of good size, variously twisted over one another, white, often with markings of light yellowish brown and purplish, the high median or dorsal carina often so roughened by the conspicuous growth lines as to be rendered irregularly spinulose. Many of the largest tubes spread along the base, forming a distinct carination on each side, along and above which the surface is often punctured by the erosion of the surface between the irregular growth lines.

The anterior portion of the animal, with the operculum, was found dried in some of the tubes. The plate on the operculum agrees perfectly with Mörch's figure. Figures of the setæ and uncial plate of a specimen from Acapulco, west coast of Central America, were given by Ehlers (1887).

The single example (999) from Vera Cruz, identified and figured by Benedict (1886) as *S. incrassatus* (Krøyer) Mörch, is not this species, and therefore should receive the new name *Spirobranchus pseudoincrassatus*. The thoracic uncini are described as having from 18 to 20 teeth.

Mörch also described and figured two related forms from the Pacific Ocean, near Puntarenas (Costa Rica, Gulf of Dulce), which do not appear to have been subsequently noted: *Hydroides (Eucarphus) crucigera* Mörch, on *Margaritifera barbata* Reeve, from 14 fathoms, and *Pomatostegus krøyeri* Mörch.

Genus *Spirorbis* Daudin 1800.

Type, *Spirorbis spirorbis* (Linné 1760) = *Spirorbis borealis* Daudin 1800. (See Pl. xxxix, fig. 34; Pl. xl, figs. 5, 6, 8, 12-15; Pl. xlii, figs. 15-19.)

Important generic characters for the animal are as follows:—Operculum protected by a calcareous plate, variable in form. Thoracic segments usually 3, rarely  $3\frac{1}{2}$  or 4 (Levinsen 1883 + Caul-

lery and Mesnil 1897). Superior thoracic setæ usually differing in form, those of the first or collar fascicle varying from those having simple tapered blades to others having a conspicuous, fin-like basal expansion.

Uncini with rather numerous equal minute teeth in 2 or 3 (?) rows. See also p. 252.

### SPIRORBIS SEMIDENTATUS sp. nov.

Pl. XXVII, figs. 7, 10; Pl. XLI, figs. 13, 17, 23, 26-30; Pl. XLIII, figs. 4, 5, 12.

*Type locality*.—Dutch Harbor, Unalaska Island.

Tube thick and massive, vitreous, rarely showing any transparency, opaque with dull surface, dextral, the few whorls not regularly rounded nor spreading, but piled one above the other, forming a high spire with nearly perpendicular sides and flattened top, without central depression, often with a distinct angular shoulder. Aperture very lustrous within, with a small round opening, the thick shell forming a broad, straight, flattened, inner or columellar margin with a conspicuous projection at its junction with the thinner straight, rounded top edge, from which it arches forward and spreads out in a shining, somewhat iridescent layer on the body of the shell; in some specimens a spiral ridge appears to arise from the outer margin, and is at first ill-defined, but increasing abruptly forms a conspicuous keel, which ends at the aperture in an angular projection; in such instances an added prominence is given to the columellar projection, giving to the aperture a two-toothed appearance. The unkeeled form strongly resembles *S. vitreus* Fabr., but forms a much higher spire and has never been seen so glassy and transparent as specimens of the latter from the Atlantic; immature examples are semitransparent. The carinated form is similar to *S. violaceus*, but is not so regularly coiled nor so deeply grooved. Others are like some forms of *S. variabilis*, but coil in the opposite direction.

Diameter 3 to 4 mm.; height the same.

Animal with 3 thoracic and about 30 posterior segments. Thoracic membrane very conspicuous, partially covering the 7 branchiæ and operculum, which expands from the stout peduncle into a cup-shaped organ the size of the rounded aperture, protected by a moderately thick, saucer-shaped, calcareous plate with an irregularly thickened inner basal ridge; it seems to be covered by a very thin membrane, to which minute protozoans are often attached; the edge of the operculum appears as a dark brown rim.

The thoracic setæ vary in the three segments. All the inferior ones are of the usual slender capillary form; the superior ones of the collar fascicle have a conspicuous, fin-like, posterior expansion and long, narrower, gradually tapered, coarsely serrate, terminal portion; those of the other fascicles have a broad, smooth, tapered blade, a few in the third fascicle with odd comb-like ends. Uncini rather broad, with two rows of minute teeth.

Posterior segments much swollen, bearing conspicuous bunches of mucous glands nearly concealing the two setæ, both of which at first have broad pennant-like blades, but farther back one has the shaft simply pointed and curved.

Strings of undeveloped eggs were in many of the tubes.

Common at Dutch Harbor, on rocks and stones; rare in Prince William Sound, at Orca, on tubes of *Serpula splendens*; and also at Sitka, on shells and tubes of *Crucigera zygophora*.

#### SPIRORBIS VARIABILIS sp. nov.

Pl. XXIX, fig. 3, a; Pl. XXXIX, figs. 24, 25; Pl. XL, fig. 4; Pl. XLIII, fig. 16;  
Pl. XLIV, fig. 17.

*Type locality*.—Sitka Harbor.

Tube thick, vitreous, usually semitransparent, sinistral, the few whorls spreading over one another, usually forming a low spire with or without a small central cavity, the top spirally grooved, the grooves in some instances indicated only by the fine sinuous striæ of growth and a slightly raised interspace, in others very deep, with three broad, rounded ridges forming conspicuous notches and tooth-like projections in the margin of the aperture, the margin in the other form being uninterrupted. There is great variation in the manner of coiling, some specimens assuming a form that can be distinguished from *semidentatus* only by its smaller size and opposite coil; others resemble *violaceus* but turn in the opposite direction.

Diameter 2–2.5 mm.; height 1–1.5 mm.

Animal not differing essentially in number of segments, branchiæ, and form of operculum from *S. semidentatus*. Some opercula have two saucer-shaped calcareous plates, which can be readily separated.

Strings of eggs were found along the back of the posterior segments.

Attached to rocks and fragments of shells, either singly or in small colonies.

## SPIRORBIS EXIMIUS sp. nov.

Pl. XXXIX, fig. 9; Pl. XLI, figs. 7, 18, 20; Pl. XLIII, figs. 6, 11, 17.

*Type locality.* — Pacific Grove, California.

Although but a single specimen, which was destroyed in getting at the animal, was found attached to a *Serpula* tube, it is noted on account of its very distinctive operculum plate.

Tube tapered, with a conspicuously corrugated surface, forming a small coil, whether dextral or sinistral was not ascertained.

Animal with 3 thoracic and about 18 posterior segments; eggs showing a distinct nucleus were in the posterior part of the body-cavity. Collar membrane very conspicuous; number of branchiæ not accurately determined.

Calcareous plate on the operculum unusually large, elongated, with large basal lobe having a distinct hook-like projection on one side, similar to that found on the operculum plate of *S. cornuarietis*, as figured by Marion and Bobretzky in 1875 (Pl. 12, f. 27, *B*).

Superior setæ of the first fascicle with conspicuously serrate edge and spiny posterior fin-like expansion; those of the other fascicles narrow smooth-edged blades, three odd ones with comb-like ends in the third fascicle. Posterior brush-like setæ very small.

## SPIRORBIS MARIONI Caullery and Mesnil 1897.

Pl. XXXIX, figs. 26, 27; Pl. XL, fig. 16.

*Type locality.* — Panama.

Small, opaque, more or less regularly coiled, dextral tubes attached to specimens of *Callopora* from La Paz, Lower California, and Panama, also to valves of *Barbatia* from Acajutla and Libertad, Central America, and to a conglomerate mass of worm tubes, coral, bryozoa, etc., from Guaymas, Mexico, resemble the larger sinistral *S. quadrangularis* Stimpson, in being four-sided. The upper surface has a deep median groove and two conspicuous ridges or carinæ, one defining an inner shoulder around the small, deep, central cavity, and the other an outer shoulder, the entire surface often roughened by growth lines.

The calcareous plate on the operculum differs from fig. 6 given by Caullery and Mesnil, only in the smaller central protuberance, a feature which is undoubtedly variable.

The collar setæ have coarsely crenulate blades and fin-like bases; the other setæ are long, regularly tapered blades, with a few odd-ended ones in the third fascicle.

## SPIRORBIS LANGERHANSI Caullery and Mesnil 1897.

*Type locality.* — Panama.

Scattered over the surface of specimens of *Crucibulum imbricatum* Sby. and *Callopora* from Panama, are numerous isolated tubes having a regularly coiled sinistral form spreading at the base, often forming a thin border around it. Four-sided in section, with the outer wall oblique and not perpendicular to the inner one, each shoulder of the comparatively narrow, flattened, dorsal area defined by a carina varying in size in different individuals; occasionally one occurs which is not regularly spiral, forming a small central cavity. The entire surface is often roughened by conspicuous transverse lines. No animals were found. Caullery and Mesnil give the collar setæ as similar to those in *S. marioni* and the plate on the operculum not unlike that found in *S. vitreus* Fabricius.

## SPIRORBIS MÖRCHI Levinsen 1883.

Pl. XXXVII, figs. 15, 24; Pl. XLI, figs. 15, 16, 21, 24, 25; Pl. XLIV, figs. 20, 21.

*Type locality.* — Greenland.

Sinistral, dull, opaque unsculptured tubes, forming low coils, with small central cavity, sometimes with upward turned aperture, are not readily identified without their animals, as they are usually more symmetrical than the form figured by Levinsen. They do not, however, differ essentially from eastern specimens on stones from the Grand Banks of Newfoundland and on *Chlamys islandicus* from Greenland.

The collar setæ have a form similar to that given by Levinsen; a long, tapered, coarsely serrate blade with conspicuous, fin-like basal portion. Setæ in the second and third fascicles, long, tapered, delicately serrate blades, a few in the third with odd comb-like ends. Uncini with comparatively coarse teeth.

Operculum not unlike that found in the eastern examples, in which it is a brood-pouch protected by a very convex, bilobed, opaque calcareous cap with a long shield-shaped posterior or inner portion, shallow at the back and extending nearly the length of the operculum in front; the eggs visible only in a back view.

Sitka, on tubes of *Crucigera*; Prince William Sound, at Orca, on the tubes of *Serpula*; also on a specimen of *Pachypoma* from Queen Charlotte Island, British Columbia, collected by the Geological Survey of Canada.

## SPIRORBIS INCONGRUUS sp. nov.

Pl. XL, figs. 19, 20, 28.

*Type locality.*— Prince William Sound.

Associated with the preceding, *S. mörchi*, are smaller, similarly coiled, but dextral tubes, slightly flattened on top, the surface roughened by growth lines, and an ill-defined spiral line feebly indicating an outer shoulder.

Collar setæ also similar to those in *S. mörchi*.

Calcareous plate in the operculum solid and somewhat resembling a plug, thus differing from that of any other species.

Diameter about 1.5 mm.; height about 1 mm.

*S. rugatus* found on stones at Sitka forms similar dextral tubes, but the collar setæ are finely serrate, tapered blades without any indication of a fin-like base.

Prince William Sound, at Orca, on *Serpula* tubes, and at Virgin Bay, on *Crucigera* tubes.

## SPIRORBIS QUADRANGULARIS Stimpson 1853.

Pl. XXXIX, fig. 37; Pl. XL, figs. 10, 11, 21, 23, 26, 30; Pl. XLII, figs. 23-29;

Pl. XLIII, figs. 14, 15.

*Type locality.*— Bay of Fundy, in 10 fathoms.

Tubes found on *Crucigera* tubes from Alaska are not four-sided, but have only a perpendicular inner wall with angular, seldom carinated, shoulder defining a small central cavity. A similar form is very common along the eastern coast, where there is found great variability in the development of the tubes. Young are often without the slightest indication of any angularity, resembling *S. spirorbis* and maturing into the form figured by Levinsen as *S. affinis*, which often twists irregularly upward like *S. lucidus*; others develop a small ridge on top of the whorls, which sometimes increases into a conspicuous carina forming three-sided whorls. Upon examination of specimens this is found to be the form called *S. granulatus* by Moore (1902) and is probably the one identified by Levinsen (1883) as the *S. carinatus* of Montagu (1803). Until the animal of specimens from England can be studied this question must remain undecided, especially as there are in the Yale Museum, on a worn bivalve from England, several sinistral, unicarinate, regularly coiled tubes, which differ from the west Atlantic form in having a large central cavity showing all the whorls, and may prove to be the true *S. carinatus*.

All the animals examined agree in having a similar convex calcareous cap on the operculum and the same form of setæ, those of the col-



lar being long, finely serrate, tapered blades with coarser fin-like bases.  
 Prince William Sound, at Orca, on *Crucigera* tubes.

### SPIRORBIS LINEATUS sp. nov.

Pl. xxxix, fig. 29.

*Type locality*. — Sitka.

Moderately thick yellowish tubes, roughened by growth lines, and 2, rarely 3, spiral threads varying in size and position in different individuals, form more or less regular sinistral coils with small central cavity. Sometimes a thread defines the central cavity, and at other times this apparently disappears and one defines an outer shoulder, the median one being constant, the three rarely occurring together. Associated with these are tubes on which the spiral lines are so feeble as to be scarcely discernible. Immature tubes with 3 spiral lines were at first taken to be worn examples of the small *S. granulatus* Linné, on which the three spirals form conspicuous thin lamellæ.

Diameter 1.5 to 2 mm.; height about 1 mm.

The collar setæ of both species are similar in form, being long, tapered, finely serrate blades with spiny fin-like bases.

Sitka, on a much-worn bivalve; and Prince William Sound, at Orca, on *Crucigera* tubes.

### SPIRORBIS SIMILIS sp. nov.

Pl. xxix, fig. 3, c; Pl. xxxix, figs. 16, 31; Pl. xl, figs. 9, 17, 18;

Pl. xliii, figs. 27, 31.

*Type locality*. — Prince William Sound.

Dull, opaque, unsculptured, usually regularly coiled, somewhat flaring, sinistral tubes with small central cavity, similar to those of *S. mörchi*.

On examination of the animal, however, the operculum plate and setæ were found to be very different in form, the collar setæ being regularly tapered, finely serrate blades, with fine fin-like bases, similar to those seen in *S. lineatus*, and the operculum, a brood-pouch filled with eggs, protected by a flat calcareous plate with a small spreading base and the usual ventral prolongation or supporting wall.

Prince William Sound, at Virgin Bay and Orca, on *Crucigera* tubes; Sitka, on fragments of rock.

### SPIRORBIS VIOLACEUS Levinsen 1883.

Pl. xli, figs. 1, 2; Pl. xlii, figs. 8-12.

*Type locality*. — Greenland.



Vitreous, strongly grooved and carinated, regularly coiled, dextral tubes agree with eastern specimens from Greenland and the Grand Banks and also with Levensen's figure.

The plate on the operculum is similar to that figured by Caullery and Mesnil (1897).

The collar setæ are like one form figured by them, but none appears to have any indication of the notch-like irregularity in the edge shown in the other form; the serrations are much coarser than in the figure given by Levensen.

Sitka, on shells; Prince William Sound, at Orca, on *Crucigera* tubes; also Queen Charlotte Island, British Columbia, on a specimen of *Pachypoma* collected by the Geological Survey of Canada.

### SPIRORBIS SPIRILLUM Linné 1760.

Pl. xxvii, fig. 8; Pl. xxxiii, fig. 15; Pl. xxxix, figs. 21, 22, 23, 28; Pl. xl, fig. 7; Pl. xlii, figs. 1-5; Pl. xliii, figs. 9, 10.

*Type locality*. — ? Ocean, on *Sertularia* and other zoophytes.

The dextral discoid form at the present time considered to be the true *S. spirillum* of Linné is very common on algæ from Cape Fox, Alaska, south to Santa Barbara, California. On the eastern coast it is very common on kelp (*Laminaria*) and on the interior of the aperture of univalves (*Buccinum*, *Sipho*, etc.) along the New England coast from Cape Cod to Greenland. The slender ascending form, the true *S. lucidus* of Montagu, also occurs on bryozoans (*Bugula mur-rayana* and other branching forms) from St. Paul Island, Bering Sea, along the coast of Alaska, south to Pacific Grove, California, where it is also attached to small univalves. On the eastern coast it occurs on bryozoans, hydroids, annelid tubes, and algæ; often attaining a large size, the var. *greenlandicus* of Mörch (*S. porrecta* of Fabricius).

The animals examined from all localities agree in having on the operculum a similar thin, shallow, calcareous plate, with slight inner or basal projection and similarly formed setæ; those of the collar geniculate—abruptly tapered serrate blades, broad and angular at base. There is considerable variation in their length and in the size of the serrations, the latter sometimes being scarcely visible, especially on those of the discoid form from Alaska.

### SPIRORBIS RUGATUS sp. nov.

Pl. xxix, fig. 3, *b*; Pl. xxxv, fig. 14; Pl. xliv, figs. 18, 19.

*Type locality*. — Sitka.

On the same fragments of rock with *S. variabilis* were a few specimens, attached singly and in a small colony, of a small dextral species

forming a regularly coiled low spire with central cavity, fragile in texture in preservation, dull opaque, roughened by conspicuous growth and occasional obscure spiral lines. As noted on page 241, they cannot readily be separated from the tubes of *S. incongruus*. Although the specimens are imperfect, their animals more or less mutilated, the following important characters could be ascertained:

Branchiæ 7.

Operculum forming a somewhat cylindrical (imperfect) brood-pouch of simple cell tissue, protected on the end by a thin calcareous cap, but showing no indication of an internal (partition) wall found in this organ in some of the eastern species. One was filled with partially developed eggs; the others had the pouch torn away, leaving the basal expansion in one instance showing the formation of a new calcareous terminal plate (Pl. xxxv, fig. 14) and in another a simple covering of tissue.

Large eggs, showing a nucleus and nucleolus when stained, were in the posterior part of the body-cavity, and smaller ones were scattered through the (10?) posterior segments.

In the 3 thoracic segments the setæ vary remarkably in form. In the collar fascicle the superior ones have very broad, conspicuously scalloped, tapered blades; in the other fascicles they are so narrow as to be scarcely distinguishable from the inferior capillary ones.

SPIRORBIS COMPTUS sp. nov.

*Type locality.* — ? California.

On a red alga from California, without definite locality, associated with *S. spirillum*, is a small, dextral, yellowish species, usually forming a low regular coil with small central cavity, often spreading around the base in a thin layer, the surface roughened by conspicuous transverse lines and three prominent spiral ridges, one defining the central cavity, one median, and one around the outer shoulder; in immature examples the median one is usually the most prominent, the others being scarcely noticeable.

Diameter 1.5 mm.; height less than 1 mm.

The animals were all much dried. In a small specimen the operculum had a thin disk-like plate with an elongated, angular basal portion. In an adult the operculum, filled with eggs, was protected by a flat calcareous cap with long basal shield.

The setæ were similar to those found in *S. rugatus*; those of the collar fascicle, simple tapered blades with serrate edges.

These tubes are much smaller and more fragile than some on shells from Pacific Grove, California, identified as *S. asperatus*.

SPIRORBIS ASPERATUS sp. nov.

Pl. XXVIII, fig. 10; Pl. XXX, fig. 4; Pl. XLI, figs. 4, 5, 6, 8, 10, 11, 19, 31, 32;  
Pl. XLIII, figs. 1, 2, 3, 7, 13, 26.

*Type locality*. — Sitka.

Tubes large, rounded, turning upward in a left-handed spiral, the turns resting one above the other or stretched out, forming variously twisted, crowded masses attached to rocks, shells, and worn tubes; opaque, yellowish, without lustre, roughened by conspicuous growth lines and sometimes with one to three more or less definite spiral threads.

Animal long and slender, with 3 thoracic and 16 to 21 posterior segments. Thoracic membrane conspicuous, nearly covering the branchiæ.

Operculum gradually enlarging from the short, stout peduncle, flattened dorso-ventrally and protected on the end by a large, thin, cup-shaped calcareous plate having a large, thin, spreading basal portion.

Superior setæ not differing essentially in form in the three segments; long, narrow, tapered, finely serrate blades; in the third fascicle a few with conspicuously fringed ends were found; as they were not seen in all of the animals examined, it could not be satisfactorily determined whether they simply failed to show in the mounting or actually do not constantly occur.

Strings of undeveloped eggs in some instances were found along the back of the posterior segments, which were much swollen, each with conspicuous bunches of mucous glands partly concealing the two setæ, one of which has the characteristic geniculate form, and the other destitute of a blade, with the end of the shaft or manubrium, pointed and curved.

Sitka, June 16, very common on rocks and shells, usually associated with bryozoa; Prince William Sound, at Orca, on *Crucigera* tubes; Pacific Grove, California, on small shells.

SPIRORBIS ABNORMIS sp. nov.

Pl. XXXIX, fig. 35; Pl. XL, figs. 1, 2; Pl. XLIII, figs. 24, 28, 29.

*Type locality*. — Sitka.

Dull, opaque, usually rounded tubes in irregular sinistral coils, the whorls often piling on one another, somewhat resemble some forms of *S. asperatus*.

The operculum differs from that of all other species in having three distinct parts, each with a similar calcareous plate. In some instances the two upper parts have been torn away, leaving one plate in the operculum which is filled with well-developed embryos, each with a conspicuous patch or mass of white, which under pressure separates into minute rods that are soluble in acid. Similar white masses have been found in the embryos in the operculum of the eastern *S. granulatus* and *S. validus*. Their exact significance has not been satisfactorily determined. They apparently have not before been noted.

Setæ finely serrate blades, not very unlike those of *S. asperatus*.

On fragments of rocks with *S. variabilis*.

#### SPIRORBIS INVERSUS sp. nov.

*Type locality*. — Port Phillip, Australia.

Isolated, minute, opaque, very lustrous, sinistral tubes, closely allied in form to *S. lucidus*, are attached to the tips of the lower or sheltered branches of a bryozoan (*Menipea cirrata* Lam.?) in the Yale University Museum.

They are remarkable for the turning downward, like a spout, of the more or less elongated terminal portion, but at first form regular flat coils. No definite characters could be obtained from the much-dried animals. No record of such a species has thus far been found.

#### SPIRORBIS TRIDENTATUS sp. nov.

*Type locality*. — Port Phillip, Australia.

Associated with *S. inversus* on the bryozoan *Menipea cirrata* are numerous other isolated white tubes which are carinated and dextrally coiled more or less irregularly upward when mature, the margin of the aperture with two deep angular incisions forming three conspicuous angular teeth.

They differ from all known forms in having the lower surface of the whorls distinctly smaller than the upper surface, the sides inclined outward forming a carinated shoulder, with the usually flattened upper surface, on which is a much larger median carina; a third defines a small, deep, central cavity, but in many full-grown specimens the inner one is inconspicuous or wanting. No animals were found.

This species may prove to be either *S. lamellosus* Lam. or *S. incisus* Mörch (*S. carinatus* Lam. non Montagu) described by Lamarck in 1818, from King Island, which is south of Port Phillip. The descriptions are inadequate for accurate identification, and the figures by Chenu have not been seen.

NOTES ON SOME PREVIOUSLY DESCRIBED SPECIES  
OF SPIRORBIS, WITH DESCRIPTIONS OF NEW  
FORMS FROM THE ATLANTIC.

**Spirorbis granulatus** Linné 1767. Pl. XL, fig. 24; Pl. XLIII, fig. 32.

This small species is well figured by Levinsen (1883, Pl. III, fig. 9; fig. 10 is a different species). It is very common on bryozoans (*Celeporaria*, *Escharopsis*, *Porella*, etc.) from the Grand Banks of Newfoundland, Gulf of St. Lawrence, and Greenland; though often larger and less regularly coiled it is readily distinguished by the three conspicuous thin lamella-like carinæ. The name, however, has been erroneously applied to several other forms, as the following: *S. granulatus* Fabricius 1780 = *violaceus* Levinsen 1883; *granulatus* Montagu 1803 = *sulcatus* Adams 1797; *granulatus* Langerhans 1880, and probably also that of Saint-Joseph 1894 = *militaris* Claparède 1868; *granulatus* Caullery and Mesnil 1897 = ?; *granulatus* Moore 1902 = triangular form of *quadrangularis* Stimpson 1853.

**Spirorbis verruca** Fabricius 1822, *non* Levinsen 1883. Pl. XLI, figs. 3, 12; Pl. XLIV, figs. 1, 16.

Numerous specimens of a good-sized, thick, opaque, white, sinistral tube with spreading base and small central cavity, attached to a valve of *Chlamys islandicus* from Greenland, are identified as *S. verruca*, as they seem to agree more closely with Fabricius' description than the larger form figured by Levinsen (1883). The surface is ornamented with one, sometimes two, small rounded spiral threads, rarely sufficiently prominent to be termed carinæ. In adults, at the upper angle of the inner or columellar margin, the edge of the aperture is tilted upward; sometimes the ends of the threads form obscure projections on the upper edge.

The calcareous plate on the operculum, which becomes a brood-pouch, can scarcely be distinguished from that of *S. validus* Verrill, but the collar setæ differ in being less numerous and in some having an obscure posterior notch.

Specimens on *Nothria* tubes from Greenland, identified by Moore 1902, on examination prove to be the discoid form of *S. validus* V.

**Spirorbis vitreus** Fabricius 1780. Pl. XLI, fig. 14; Pl. XLII, figs. 6, 7.

Some immature forms of this dextral hyaline species have a rounded thread or cingulum on the top of the whorls, ending at the aperture in a tooth-like projection.

Found on stones and shells from the Grand Banks of Newfoundland, and on a fragment of shell from Devonshire, England.

*Spirorbis cancellatus* Fabricius 1780. pl. xxxix, fig. 36; pl. xl, fig. 27; pl. xlii, figs. 30-34.

A dextral, vitreous, grooved and carinated form, associated with numerous specimens of *S. sulcatus* Adams, is attached to a worn limpet shell from Birterbuy Bay, Ireland. Small notches along the edge of the base indicate the possibility of its proving to be an undeveloped or maturing specimen of *S. cancellatus* Fabr. not before recorded from Great Britain. It may be *S. conicus* Fleming (1825) which Mörch placed as a variety of *S. vitreus* Fabr.

*Spirorbis communis* Bosc 1802.

No satisfactory conclusion can be reached in regard to this species, owing to the very brief description and indefinite locality. The figure given by Bosc represents a regularly coiled sinistral form with smooth surface, similar to *S. spirorbis* Linné.

*Spirorbis corrugatus* Montagu 1803, *non* Caullery and Mesnil 1897.

On a stone from Birterbuy Bay, Ireland, are four species of *Spirorbis*. The most numerous form is of good size, sinistral, the last whorl usually covering all the others, forming a central pit; sometimes irregularly coiled, with the aperture turning upward. Surface in perfect condition, very lustrous and smooth, but as this epidermal layer is easily destroyed many of them have the surface roughened by numerous transverse lines, but no spiral ones. These apparently agree with Montagu's description. The dextral form sometimes having spiral lines, identified and figured by Caullery and Mesnil (1897) as this species, must be distinct, for which the name *pseudocorrugatus* is proposed. The form described and figured by Langerhans (1880) is also dextral.

*Spirorbis heterostrophus* Montagu 1803.

A regularly coiled, small, dextral form has the surface cut by grooves and carinae which increase with age, so that fully developed specimens are distinctly tricarinate, the entire surface often roughened by transverse lines. Another small dextral form, which is considered distinct, has two, three, or more rounded spiral threads and no grooves. This one does not appear to have been mentioned by Montagu or others. A third dextral form has a single dorsal carina and may prove to be *S. carinatus* Montagu or *S. minutus* Montagu.

**Spirorbis carinatus** Montagu 1803.

As already stated (p. 241), there is considerable doubt in regard to this species. The form described by Fleming (1825) is certainly very similar to *S. quadrangularis* Stimpson, but it is not improbable that both species occur on the English coast. In the Yale University Museum are two unicarinate, regularly coiled forms, one dextral, attached to a valve of *Anomia* from Guernsey, England, and to a stone from Birterbuy Bay, Ireland, and the other sinistral, attached to a worn valve from England; neither is like the carinate, triangular, immature form of *S. quadrangularis* from Eastport, Maine, and from Greenland.

**Spirorbis sulcatus** Adams 1797; *S. granulatus* Montagu 1803, *non* Linné 1767. Pl. xli, fig. 9; Pl. xliii, figs. 8, 19.

Attached to a *Haliotis tuberculata* from Guernsey, England, and to a worn limpet shell from Birterbuy Bay, Ireland, are numerous thick, more or less regularly spirally coiled, sinistral tubes, having a deep groove on top of the whorls, when adult, with a large rounded carina on each side, the inner one defining the small central cavity; in very large specimens another much shallower groove appears on the side of the whorl, with a much smaller carina or thread along its lower edge. The surface, when perfect, has considerable luster. This species is much larger and thicker than the dextral tricarinate form identified as *S. heterostrophus*, and is without question the *S. granulatus* Montagu 1803, *non* Linné 1767, and therefore must take the name *sulcatus*, used by Adams 1797 (Linnean Transactions, iii, p. 254), *non* Lamarck 1818.

By the use of potash solution the dried animals were taken from some of the tubes, and the calcareous plate on the operculum and the setæ were found.

**Spirorbis validus** Verrill 1874. Pl. xxxvii, figs. 5, 6, 7, 8, 10, 32; Pl. xlii, figs. 11-14.

This, the largest of all species of *Spirorbis*, varies greatly in its manner of coiling, there being a marked contrast between the regular sinistral form figured by Levinsen as *S. verruca* Fabr. and others, where the whorls lie one above the other, forming a high irregular spiral. No difference, however, could be found in the essential characters of their animals. In all the specimens examined, the branchiæ number 13 (in very large adult forms Verrill counted 15) and all the setæ have long, slender, finely serrate, tapered blades.



**Spirorbis stimpsoni** Verrill 1879. pl. xxxix, fig. 38; pl. xl, fig. 29; pl. xliii, figs. 20, 21, 22.

This species forms regularly coiled sinistral tubes with large central cavity, the aperture occasionally turned upward, the surface often roughened by growth lines and a small rounded median thread.

**Spirorbis pusilloides** nom. nov. for *Mera pusilla* Saint-Joseph 1894.

As the *pusilla* of Saint-Joseph is now referred to the genus *Spirorbis*, and as this specific name was used by Rathke in 1836 for a form from the Black Sea, *S. pusilloides* is proposed for Saint-Joseph's species.

**Spirorbis pseudocorrugatus** nom. nov. for *S. corrugatus* Caullery and Mesnil 1897, *non* Montagu 1803 (see p. 248).

**Spirorbis foraminosus** Bush 1904.

Tubes forming a good sized dextral discoid coil, the surface ornamented with 3 carinae, the median one the most prominent, on both sides of which the slightly concave surface is punctured by irregular minute holes or foramina apparently caused by the erosion of the epidermal layer; immature forms probably having the surface crossed by numerous transverse lines. The operculum, which is a brood-pouch, is elongated, cylindrical, filled with eggs, the calcareous plate a simple disk with flaring rim with large shield-shaped basal portion attached posteriorly to a secondary calcareous disk on the end of the operculum proper. Setae with simple tapered blades, those on the collar the broadest and more abruptly tapered than the others.

**Spirorbis bellulus** Bush 1904.

Tube dextral, regularly coiled, with small central cavity, the surface ornamented with 3, sometimes 4, unequal rounded threads, the one on the summit the most prominent. The calcareous plate on the operculum somewhat angular, with deep upright thickened rim. Setae with long slender tapered blades, those on the collar with comparatively coarse serrations.

**Spirorbis dorsatus** Bush 1904.

Tube dextral, regularly coiled, with a single high median ridge on the last whorl. No animal found.

**Spirorbis argutus** Bush 1904.

Tube sinistral, forming a low discoid coil with large central cavity, spreading around the base in a thin layer, the whorl rapidly enlarging and ornamented with one large median keel and numerous distinct



transverse lines. Calcareous plate on the operculum thin, disk-like, slightly thickened in the center. Setæ with simple tapered blades.

**Spirorbis tubæformis** sp. nov. Pl. XXXIX, figs. 30, 32; Pl. XLII, figs. 13, 14.

Small, opaque, white sinistral tubes common on Irish moss (*Chondrus*) from Long Island Sound, southern New England, at New Haven, Connecticut, closely resemble the dextral *S. sinistrorsus* common on lobsters from Cornwall, England, in the Yale University Museum. The central cavity is smaller than in *S. spirorbis* Linné, not showing so much of the earlier whorls, the last whorl being more spreading or trumpet-shaped. In the adult form, which is rarely found, the surface sometimes becomes roughened by irregular growth lines, and the whorls appear rounder and turn upward after the manner of *S. lucidus*, but in the opposite direction. Collar setæ with fine serrate blades and coarser fin-like bases similar to those of *S. spirorbis*.

**Spirorbis evolutus** sp. nov. Pl. XLII, figs. 20, 21, 22.

Smooth, opaque, rather fragile sinistral tubes are attached to the inside of the aperture of a shell (*Sipho*) from the Grand Banks of Newfoundland. The early whorls are coiled in a regular discoid form, from which the tube stretches out and becomes evolute, more or less irregularly curved, sometimes twisted, increasing abruptly in size and forming a long, somewhat trumpet-shaped portion. They are usually separated, but sometimes spread over one another. In the five specimens stained and mounted in glycerine, the number of branchiæ is apparently 9, but this is impossible to determine with accuracy, as they have become much matted in preservation. The operculum is of the ordinary form, with the thin calcareous terminal plate having an unusually long, somewhat spreading basal portion. Body-cavity distended with well-developed eggs. Posterior portion very short, number of segments indeterminable; only a few setæ and scarcely discernible uncini were visible. Setæ of the collar fascicle slender, long, rounded at base, with faintly serrate edges, one or two with a slight posterior notch.

**Spirorbis formosus** sp. nov. Pl. XXXIX, figs. 18, 19; Pl. XLI, fig. 22; Pl. XLIII, figs. 18, 23, 25, 30.

Small, regularly coiled, dextral, yellowish tubes, very common on gulf-weed (*Sargassum*) from the Gulf Stream and Bermuda, where they are also found on shells, are ornamented on top with two or three,

often unequal, spiral threads or carinæ, the interspaces crossed by numerous raised transverse lines which extend over the side, and in fully developed specimens spread around the base. The operculum is furnished with a peculiar calcareous cylinder in which well-developed embryos, some with good sized setæ, have been found. Some specimens collected at Bermuda in February 1904, by Mr. Dwight Blaney, have two complete cylinders, one above the other, on the operculum; others have a single large cylinder filled with well-developed eggs. All the thoracic setæ have narrow tapered blades.

***Spirorbis mutabilis* sp. nov.**

Smaller, more or less regularly coiled sinistral tubes are found on various shells at Bermuda, often with the preceding species.

The surface is usually but little roughened, but sometimes very faint spiral lines occur, and in rare instances, when the development has not been impeded, the surface is ornamented with two keels which define the flattened top, giving a four-sided appearance; sometimes the aperture is turned upward. The operculum is furnished with a thin, more or less concave calcareous plate with small base. Some of the opercula were filled with globular masses and others were of the ordinary form. In some instances egg-chains were found in the tubes along the dorsal furrow. The collar setæ have long, tapered, coarsely serrate blades with conspicuous fin-like bases.

NOTES ON THE GENUS *SPIRORBIS*, WITH A LIST  
OF DESCRIBED SPECIES.

The genus *Spirorbis* seems to have been purposely avoided by most authors, little systematic work having been done since Mörch, in 1863, published the descriptions, with added notes, of all of the earlier described species, straightening out much of the confusion in their synonymy.

Levensen, in 1883, was the first to make a thorough study of the northern species, by dissecting the animals, and has, by his excellent figures of their tubes and important collar setæ, done much toward rendering it possible to correctly identify them.

As little had been published in regard to the importance of the operculum, with its protective calcareous plate, in connection with the writer's study of the Alaska species, the animals of numerous Atlantic forms found along the coast from Greenland to Bermuda have been dissected with special reference to this character. The investigations were

completed before the valuable article<sup>1</sup> on *Spirorbis*, published by Caullery and Mesnil in 1897, could be consulted. It was found that these authors had made special and careful observations on the opercula, with their calcareous plates, of many species, giving excellent figures, as well as figures of the important collar setæ. In connection with their studies of material obtained at the laboratories of St.-Vaast-la-Hougue on the English Channel, and from the French Expedition to Cape Horn, these authors also borrowed specimens from the Museum of Copenhagen (from Levinsen), the Paris Museum, and the Faculty of Science of Lyons, besides special species from Marenzeller and Marion, so that their list includes 27 species, 12 of which are described as new, and their results far exceed in value any hitherto published. Owing to the limited time allowed for the perusal of this paper, only the most important facts could be noted, and it has been found impossible to determine to what degree the following observations may be a repetition of those of Caullery and Mesnil.

In those species in which the embryos are developed in the tube, as in *S. spirorbis* Linné, *S. spirillum* Linné, *S. asperatus* sp. nov. etc., the operculum is used simply as an organ of protection in closing the aperture of the tube; while in others, as *S. granulatus* Linné, *S. validus* Verrill, *S. stimpsoni* Verrill, *S. quadrangularis* Stimpson, etc., it has an added purpose, by being differentiated into a thin-walled, pouch-like cavity in which the embryos are fully developed. It is protected on the end by a calcareous plate or cap, varying in form, having near its inner or ventral edge a more or less developed basal portion. In species where there is but a slight basal thickening, as *S. semidentatus* sp. nov., the plate appears to be more or less embedded in the operculum, and minute protozoans, sponges, etc., are often affixed to its exposed surface; but in others, where there is an elongated, more or less shield-shaped base, special muscles are joined to the free end, apparently governing the movement of the plate, as they appear to extend downward through the peduncle to the muscular layer of the body, such muscle fibers often remaining attached when the plate has been dissected. When the operculum becomes differentiated into a brood-pouch a larger basal portion develops, which is usually shallow behind and long in front, sometimes reaching nearly the depth of the operculum, forming a stiff wall, thus protecting the

<sup>1</sup> Considerable difficulty was experienced in obtaining a copy of this article; as lack of time prevented application to the authors themselves, it was borrowed by Mr. Van Name, the Librarian of the University Library, from the Surgeon General's Office in Washington, D. C.

embryos. In some instances this appears to be simply an addition over or in front of the first base, and in others an entirely new plate develops, which pushes the primary one forward until it becomes entirely disconnected and ultimately lost. A series showing this interesting feature was found in *S. validus* V. (Pl. XLIV, fig. 14). In some instances this second base appears to be formed by a network of calcareous deposit over the surface of that portion of the operculum, and in others it seems to be composed of minute granules. In some instances the primary plate itself is repeated, as in *S. variabilis* sp. nov., where the calcareous disk is composed of two layers easily separable into two complete disks (Pl. XLIII, fig. 16), and in *S. abnormalis* sp. nov., where there were three similar plates, attached one above the other, the operculum itself appearing to be divided into three chambers, the posterior one containing well-developed embryos (Pl. XLIII, figs. 24, 28, 29). In *S. formosus* sp. nov., where nearly the entire operculum becomes a calcareous cylinder, the primary base was seen inside the cylinder (Pl. XLIII, fig. 30), when this was severed from its peduncle, and another plate in process of development was found in the expanded end (Pl. XLIII, fig. 23), which apparently was to become another operculum; two complete cylinders have also been found attached one above the other. This and other instances where the brood-pouch, apparently having split along the back and discharged its embryos, was becoming torn away, revealing a calcareous disk beneath it, points to the fact that in *Spirorbis* the animal has the power of renewing its operculum on the same side of the body, instead of forming a secondary one on the opposite side, as in *Serpula*, *Crucigera*, etc. Caullery and Mesnil found a close relationship between the direction of the coiling of the tube and the development of the animal; that all dextral forms had the operculum on the right side and all sinistral ones on the left side, presumably differentiated from the second branchia. It would therefore seem improbable that any species could turn in both directions, that is, have both a right and left form, an opinion held by some investigators; hence the direction of the coiling of the tube is of first importance in determining species.

The embryological development of a number of species has been studied by several authors—Pagenstecher 1862 (*S. pagenstecheri* Qtr. 1865); Agassiz 1866 + Willemoes-Suhm 1871 + Saint-Joseph 1894 + Schively 1897 (*S. spirorbis* L.); Claparède 1868 (*S. lavis* Qtr.), Fewkes 1885 (*S. spirillum* L.); Saint-Joseph 1894 (*S. pusilloides* nom. nov.)—and hermaphroditism has been found to be the rule. Nearly all agree that the spermatozoa are carried in the posterior

setigerous segments, some maintain that the ova are found only in the first two or three of these segments, others that they occur only in the middle or body-cavity, which ruptures along its convex side, permitting the eggs to escape into the tube, where they are developed. In preserved specimens of *S. spirorbis* strings or chains of embryos showing well-formed setæ have been found lying along the back, apparently coming from an opening in the body-cavity just back of the thorax. In several specimens, when stained and mounted, eggs showing nucleus and nucleolus have been seen in both the body-cavity and (smaller ones) in the first few posterior segments, but no spermatozoa were noticed, the posterior segments being usually filled with minute granules (oil drops?), with the mucous glands on their dorsal surface very conspicuous, especially when eggs were found in the tube. Miss Schively, however, who carried on her investigations during two seasons, examining specimens from eight different localities in Vineyard Sound and Buzzard's Bay, states "that *S. borealis* has two breeding seasons. One of these extends from the middle of June to the middle of July; the other extends through the month of August. During the last two weeks of July no eggs were found either in the body-cavity or in the shell." "The eggs pass out through the operculum; its end bears a movable translucent plate of lime, etc." "The reproductive glands are arranged on either side of the intestinal canal near the stomach. Where the ova and sperm is developed is distinguished merely by the presence of the product. The eggs pass into the body-cavity and from here into the operculum, where they are fertilized and a capsule is secreted; from here they pass out through the opening of the operculum and are placed in the mid-dorsal furrow. The operculum does not serve for a brood-pouch as does that of *S. spirillum*." She probably refers to the species studied by Pagenstecher in 1862, which he erroneously identified as *S. spirillum*, to which Quatrefages in 1865 gave the name *S. pagenstecheri*. In the many specimens recently examined, of *S. spirillum* Linné detached from kelp (*Laminaria*), chains of eggs have been found in the tube. This is supposed to be the species studied by Fewkes in 1885, as *S. borealis*; the *S. spirillum* of Agassiz (1866) is *S. borealis* Daudin = *S. spirorbis* Linné.

Saint-Joseph (1894) states that he found in *Mera pusilla* (*Spirorbis pusilloides* nom. nov.) not only well-developed embryos in the operculum, but large ova in the first two abdominal segments and spermatozoa in the following ones. In one instance only were spermatogonia and spermatozoa seen (see Addendum); but the other features were noted

in many of the species studied. In *S. validus* collected the latter part of June, also in *S. granulatus*, the embryos taken from the operculum had the setæ well developed, and each was partially concealed by a conspicuous white patch, which under pressure split into minute short rods, quickly destroyed by acid. The exact significance of this white patch has not been satisfactorily determined, owing to its being now noted, apparently for the first time, in preserved animals. It is a well-known fact that embryos developed in the tube of the parent, on escaping, immediately on reaching a suitable host, begin to build their tubes, so that it might be possible that these embryos, when the specimens were collected, were about escaping from the pouch, and that their growth or movements were not immediately interrupted and the lime was formed which would have constructed their tubes. On the other hand, the mass may cause the embryo to sink rapidly, enabling it more readily to find a host, as it must necessarily escape from the brood-pouch into the open sea, at some distance from a suitable object for attachment. Not until a series of animals has been properly prepared in sections, and a comparative study is made of many species, will it be possible satisfactorily to determine their internal structure. It is found in comparing the published results of the studies of isolated species that there are apparent contradictions, and important points remain unexplained.

Caullery and Mesnil, like Levinsen, found that the number of thoracic segments varied, sometimes increasing to 4 on one side; combining this fact with that of the development of the operculum on the right or left side, they divided the genus *Spirorbis* into new subgenera — *Paradexiospira*, *Dexiospira*, *Paralæospira*, *Læospira* and *Romanchella* — discarding all of Saint-Joseph's generic names, excepting *Leodora*, which they thought might prove to be the same as the last, stating that they were unable to follow that author in referring the species to his six widely separated genera.

As it is impossible always accurately to determine the number of thoracic segments, often owing to the very poor condition of the animals in preservation, such a division, although of much interest, does not appear of any more practical value in determining the relationship of species than does the method adopted by Saint-Joseph. The analytical table of species given by these authors includes too many characters to be readily used.

Saint-Joseph (1894), in his analytical table for the Scrupulas, makes the number and size of the teeth on the uncial plates of greatest importance. He seems, however, to have erred in describing and figur-



ing the uncial plates of *Spirorbis borealis* Daudin as having the lowest tooth larger than the others, as this does not appear to be the case in any of the species studied. The embedded portion does not extend to the end of the thicker surface plate, on which the teeth seem evenly spaced. He bases his subordinate divisions on the differences in form, not only of the collar setæ, but of all the others, with the result that species of *Spirorbis* are widely separated and referred to other genera, as instanced in the following :

*Spirorbis*, with *S. borealis* Daudin as type, is placed under his second grand division with *Filograna* Oken, *Salmacina* Claparède, and *Filogranula* Langerhans. *Spirorbis granulatus* Linné is referred to *Pileolaria* Claparède, type *P. militaris* Clap.; *S. pagenstecheri* Quatrefages to *Janua* gen. nov. as type; *S. corrugatus* Montagu and *S. lucidus* Montagu to *Circeis* gen. nov., type *C. armoricana* Saint-Joseph; *S. lavis* Quatrefages to *Leodora* gen. nov. as type.

It can be readily seen by this and a further study of the relative positions of these genera that such an arrangement can be adopted only by ignoring the generic importance, not only of the presence of a calcareous plate in the operculum, but also the number of thoracic segments.

The few odd setæ—long blades with deeply serrate (comb-like) ends, similar to those of *Apomatus*<sup>1</sup> Philippi 1844 (type, *A. ampulliferus*), and short setæ like those of *Salmacina* Claparède 1870 (type, *S. incrustans*)—said to be found on the second and third thoracic segments are also given generic value. In the large number of animals examined, however, only the long form has been noticed in the third fascicle, although in a few instances these varied in length in the same bundle, but they were not always found. Whether they simply failed to show in the mounting, or really do not always occur, or occurring only during the breeding season are easily lost, has yet to be determined; therefore it seems undesirable to make them of much importance. Caullery and Mesnil (1897) arrived at the same conclusion, and, finding it impossible to follow Saint-Joseph, discarded five of his generic names, but proposed other subgeneric ones based on different characters (see p. 256).

As the form of the superior collar setæ is of first importance in identifying species, and with care can be invariably determined even in very poorly preserved specimens, an attempt has been made to de-

<sup>1</sup>These are also very like some of the dorsal setæ found in *Amphitrite*, as figured by Saint-Joseph (1894).

vise a simple method of arranging the various species, based on this character. By comparing the different forms, which vary from narrow tapered blades to those having a conspicuous fin-like base, they are found to grade into one another, and fall into the following natural divisions or groups, to which apparently Saint-Joseph's names can be applied:

A. In the forms having the distinct fin-like base, the fin angular or rounded, there are apparent differences in the serrations, which are separable into two groups. In the first the serrations on the edge of the blade are comparatively fine and the spines on the fin usually much coarser (Pl. XL, fig. 12). Taking *Spirorbis borealis* Daudin, now considered synonymous with *S. spirorbis* Linné, as the type species, there should be a few (3 to 5) odd setæ with elongated fringed ends in the third fascicle of thoracic setæ. This is *Spirorbis* in its strictest sense.

B. In the second form the serrations become very coarse on both the blade and fin (Pl. XXXVII, fig. 24). As *militaris* Claparède falls into this group, it is equal to the genus *Pileolaria* Claparède + Saint-Joseph, which, according to the latter, has no odd setæ.

C. The form with rounded fin gives rise to those in which the fin is defined only by a more or less definite notch, which entirely disappears, forming simple tapered blades (Pl. XLI, fig. 3). In this group are both *pagenstecheri* Quatrefages, referred to *Janua* by Saint-Joseph as type, and *pusillus* Saint-Joseph, referred to *Mera* as type. The first is described as having the odd setæ of *Apomatus* on one or more segments, while the second has them on the third only, so that there seems to be no distinguishable difference between them, except in the form of the operculum. *Mera* therefore becomes synonymous with *Janua*, the name of this third group.

D. The form with angular fin gives rise to a simple blade, broadly angular at base, found in *armoricanus* Saint-Joseph, referred to *Circeis* as type (Pl. XLI, figs. 1, 2).

E. Instead of being angular, the blade becomes broadly rounded at base, as in *levis* Quatrefages, referred by Saint-Joseph to *Leodora* as type. Caullery and Mesnil suggested the possibility of this proving synonymous with the following group.

F. The blades become long, narrow, regularly tapered, and similar in all three fascicles, as in *perrieri* Caullery and Mesnil, the type of *Romanchella* Caullery and Mesnil (Pl. XXXVII, fig. 8).

None of these groups or divisions are sufficiently disconnected or distinct to give them generic (after Saint-Joseph) or subgeneric (after Caullery and Mesnil) value. But since the names have been proposed,



they are retained only as sectional ones in the following table (p. 261), especially as setæ of similar forms are found in genera which differ from *Spirorbis* in the number of thoracic segments, in the form and substance of the plate in the operculum, and in some instances in lacking an operculum.

As a large number of species are known only by their tubes, the animals of comparatively few having been studied with reference to the form of their collar setæ, two simple methods have been adopted in grouping them, as a possible aid to their correct identification: One based on a knowledge of the tube (see p. 260), and the other on the form of the superior collar setæ (see p. 261).

Levensen (1883) used the terms 'sinistral' and 'dextral' in grouping the northern species, but also retained (after Mörch) the substance<sup>1</sup> of the tube as an equally important character. As this, however, is found to change sometimes with growth, and also to be more or less affected in preservation, it cannot always be defined with accuracy, and might prove misleading. Therefore the direction of the coil and the character of the surface of the tube are the only points considered in the first table.

To avoid repetition and confusion of names, a list of all the recognized species, as far as known, is given after the two tables. They are arranged chronologically, and with each is given its principal synonyms and reference to figures, also the principal localities at which it has been found. As the numerals used by Caullery and Mesnil in their recent and very important work (1897) show the arrangement of species in their subgeneric relation as well as to one another, this number is given after the names of these authors. Names with an asterisk show that the species has been studied and is in the Yale University Museum.

Of the 73 species cited, only 59 could be placed in the first table, although the position of some of these may be questioned, and but 41 in the second table. The necessary further study of the others may prove some of them to be but synonyms there being 14 species having the tube inadequately described and 32 about which nothing is apparently known of the animal.

<sup>1</sup> Crystalline, vitreous, cretaceous, porcellaneous, etc., have been used.

## TABLE I.

BASED ON CHARACTER OF SURFACE OF TUBE, WHICH, WHEN FULLY DEVELOPED, IS SMALL, MORE OR LESS REGULARLY COILED, DISCOID, ASCENDING, OR SPREADING.

**A. Surface without lines or grooves.**

Tube sinistral.

- |  |   |
|--|---|
| <i>Spirorbis spirorbis</i> Linné (18) <sup>1</sup> | <i>Spirorbis claparedei</i> C. & M. (11). |
| <i>communis</i> Bosc.                              | <i>nordenskjöldi</i> Ehlers (surface?).   |
| <i>corrugatus</i> Montagu non C. & M.              | <i>similis</i> sp. nov.                   |
| <i>chilensis</i> Gay (surface?).                   | <i>abnormis</i> sp. nov.                  |
| <i>lævis</i> Quatrefages.                          | <i>inversus</i> sp. nov.                  |
| <i>validus</i> Verrill (17).                       | <i>tubæformis</i> sp. nov.                |
| <i>mörchi</i> Levinsen (27).                       | <i>evolutus</i> sp. nov.                  |
| <i>aggregatus</i> C. & M. (10).                    |   |

Tube dextral.

- |                                       |   |
|---------------------------------------|---|
| <i>Spirorbis spirillum</i> Linné (4). | <i>Spirorbis armoricanus</i> Saint-Joseph (5) |
| <i>sinistrorsus</i> Montagu.          | <i>pusilloides</i> nom. nov. (9).             |

**B. Surface variable: with and without lines.**

Tube sinistral.

- |  |  |
|--|--|
| <i>Spirorbis verruca</i> Fabr. non Levinsen. | <i>Spirorbis levinseni</i> C. & M. (15). |
| <i>quadrangularis</i> Stimpson.              | <i>asperatus</i> sp. nov.                |
| <i>malardi</i> C. & M. (12).                 | <i>mutabilis</i> sp. nov.                |
| <i>lebruni</i> C. & M. (14).                 |  |

Tube dextral.

- |  |                                   |
|--|-----------------------------------|
| <i>Spirorbis vitreus</i> Fabr. (2).    | <i>Spirorbis rugatus</i> sp. nov. |
| <i>pseudocorrugatus</i> nom. nov. (7). | <i>incongruus</i> sp. nov.        |
| <i>semidentatus</i> sp. nov.           |                                   |

**C. Surface with distinct lines and grooves.**

Tube sinistral.

- |  |   |
|--|---|
| <i>Spirorbis granulatus</i> Linné.               | <i>Spirorbis perrieri</i> C. & M. (16). |
| <i>carinatus</i> Montagu.                        | <i>mediterraneus</i> C. & M. (19).      |
| <i>sulcatus</i> Adams.                           | <i>köhleri</i> C. & M. (22).            |
| <i>cornuvarietis</i> Philippi (20). <sup>2</sup> | <i>bernardi</i> C. & M. (23).           |
| <i>militaris</i> Claparede (24).                 | <i>langerhansi</i> C. & M. (26).        |
| <i>stimpsoni</i> Verrill.                        | <i>argutus</i> Bush.                    |
| <i>beneti</i> Marion (21).                       | <i>variabilis</i> sp. nov.              |
| <i>patagonicus</i> C. & M. (13).                 | <i>lineatus</i> sp. nov.                |

Tube dextral.

- |   |                                       |
|---|---------------------------------------|
| <i>Spirorbis cancellatus</i> Fabr. (1). | <i>Spirorbis bellulus</i> Bush.       |
| <i>heterostrophus</i> Montagu.          | <i>dorsatus</i> Bush.                 |
| <i>violaceus</i> Levinsen (3).          | <i>eximius</i> sp. nov. (direction?). |
| <i>marioni</i> C. & M. (6).             | <i>comptus</i> sp. nov.               |
| <i>pagenstecheri</i> Quatrefages (8).   | <i>tridentatus</i> sp. nov.           |
| <i>foraminosus</i> Bush.                | <i>formosus</i> sp. nov.              |

<sup>1</sup> See pp. 236 and 262.

<sup>2</sup> See Addendum.

## TABLE II.

BASED ON FORM OF SUPERIOR COLLAR SETÆ.

**A. Setæ having a long tapered blade preceded by a fin-like expansion.***Spirorbis* Daudin 1800.*a.* Serrations on the blade fine, usually much finer than on the fin.*Spirorbis* Daudin 1800 st. s.

Tube sinistral.

*Spirorbis spirorbis* Linné (18).<sup>1</sup>*Spirorbis patagonicus* C. & M. (13).*granulatus* Linné.*lebruni* C. & M. (14).*sulcatus* Adams.*köhleri* C. & M. (22).*quadrangularis* Stimpson.*bernardi* C. & M. (23).*stimpsoni* Verrill.*lineatus* sp. nov.*aggregatus* C. & M. (10).*similis* sp. nov.*claparedi* C. & M. (11).*tubæformis* sp. nov.*malardi* C. & M. (12).*b.* Serrations on the blade coarse, similar on fin.*Pilcolaria* Claparède 1870.

Tube sinistral.

*Spirorbis cornuarietis* (Philippi) (20). *Spirorbis beneti* Marion (21).*militaris* Claparède (24).*langerhansii* C. & M. (26).*mörchi* Levinsen (27).*mutabilis* Bush.*levinseni* C. & M. (15).*variabilis* sp. nov.*mediterraneus* C. & M. (19).

Tube dextral.

*Spirorbis cancellatus* Fabr. (1).*Spirorbis semidentatus* sp. nov.*vitreus* Fabr. (2).*eximius* sp. nov. (direction?).*marioni* C. & M. (6).*incongruus* sp. nov.**B. Setæ having the blade of two forms: with and without a shallow posterior notch.***Janua* Saint-Joseph + *Mera* Saint-Joseph 1894.

Tube sinistral.

*Spirorbis verruca* Fabr. non Levinsen. *Spirorbis evolutus* sp. nov.

Tube dextral.

*Spirorbis pagenstecheri* Quatr. (8). *Spirorbis pusilloides* nom. nov. (9).**C. Setæ having the blade distinctly angulated at base.***Circeis* Saint-Joseph 1894.

Tube dextral.

*Spirorbis spirillum* Linné (4).*Spirorbis armoricanus* Saint-Joseph (5).*violaceus* Levinsen (3).**D. Setæ having the blade broadly rounded at base.***Leodora* Saint-Joseph 1894.

Tube sinistral.

*Spirorbis lævis* Quatrefages.

Tube dextral.

*Spirorbis pseudocorrugatus* nom.  
nov. (7).*Spirorbis rugatus* sp. nov.  
*comptus* sp. nov.<sup>1</sup> See p. 258.

**E. Setæ having the blade regularly tapered.***Romanchella* Caullery and Mesnil 1897.

Tube sinistral.

*Spirorbis validus* Verrill (17).*Spirorbis asperatus* sp. nov.*perrieri* C. & M. (16).*abnormis* sp. nov.*argutus* Bush.

Tube dextral.

*Spirorbis foraminosus* Bush.*Spirorbis formosus* sp. nov.*bellulus* Bush.**SPECIES OF SPIRORBIS ARRANGED IN ORDER OF DATE OF PUBLICATION.**

An asterisk [\*] after the name of a species indicates that specimens are in the Yale University Museum.

1760. SPIRORBIS SPIRORBIS\* Linné + Fabricius 1780 + Montagu 1803, in part, + Cuvier (figures). (See pp. 236 and 258.)

*borealis* Daudin 1800 + Mörch 1863 + Malmgren 1867 + Levinsen 1883 (figures) + Saint-Joseph 1894 (figures) + Caullery and Mesnil 1897 (18; figures) + ? Schively 1897 (embryology; figures).

*nautiloides* Lamarck 1818 + Willemoes Suhm 1871 (embryology; figures).

*spirillum* Agassiz 1866 (embryology; figures) *non* Linné.

Pl. XXXIX, fig. 34; Pl. XL, figs. 5, 6, 8, 12-15; Pl. XLII, figs. 15-19.

Northern waters, on stones and rock-weed (*Fucus*); ? on other hosts.

1760. S. SPIRILLUM\* Linné + Fabricius 1780 + ? Montagu 1803 + ? Mörch 1863 + Malmgren 1867 + Levinsen 1883 (figures) + Caullery and Mesnil 1897 (4) + Moore 1902. (See p. 243.)

*lucidus* Montagu 1803 (figures) + Mörch 1863 + Malmgren 1867 + Saint-Joseph 1894; variety *grönlandicus* Mörch 1863 (*porrecta* Fabricius 1780 *non* Müller).

*borealis* Fewkes 1885 (embryology; figures) *non* Daudin 1800.

Pl. XXVII, fig. 8; Pl. XXXIII, fig. 15; Pl. XXXIX, figs. 21-23, 28; Pl. XL, fig. 7; Pl. XLII, figs. 1-5; Pl. XLIII, figs. 9, 10.

Northern waters, very common, both Atlantic and Pacific; from Cape Cod, Massachusetts, coast of New England to Greenland, and from Bering Sea to California, from shallow water to 90 fathoms, on shells (*Buccinum*, *Sipho*, etc.), on algæ (*Laminaria*, etc.), on bryozoans (*Cellularia*, *Crisia*, *Gemellaria*, *Bugula*, etc.), on hydroids (*Obelia*, *Salacia*, *Eudendrium*, *Sertularia*, *Thuiaria*, etc.), and on worm tubes (*Nothria*, etc.); England, on bryozoans (*Salicornaria*, etc.).

1767. S. GRANULATUS\* Linné + Mörch 1863 + Malmgren 1867 + Levinsen 1883, in part (tab. III, f. 9 not 10), *non* Fabricius 1780 + Montagu 1803 + Langerhans 1880 + Saint-Joseph 1894 + Caullery and Mesnil 1897 (25; figure) + Moore 1902. (See p. 247.)

Pl. XL, fig. 24; Pl. XLIII, fig. 32.

- Northern waters, from Bay of Fundy, Grand Banks of Newfoundland, Gulf of St. Lawrence, and Greenland, on bryozoans (*Celleporaria*, *Porella*, *Escharopsis*, etc.).
1780. *S. VITREUS* \* Fabricius + Mörch 1863 + Malmgren 1867 + Levinsen 1883 (figures) + Caullery and Mesnil 1897 (2 ; figures) + Moore 1902. (See p. 247.)  
 Pl. XLI, fig. 14 ; Pl. XLII, figs. 6, 7.  
 Northern waters, from Grand Banks of Newfoundland, in 59 to 120 fathoms, on stones and shells (*Sipho*, *Buccinum*, etc.) ; Greenland, on shells (*Chlamys islandicus*), bryozoans, and worm tubes (*Nothria*, etc.) ; Devonshire, England, on shells.
1780. *S. CANCELLATUS* \* Fabricius + Dawson 1860 (figures) + Mörch 1863 + Malmgren 1867 + Levinsen 1883 (figures) + Caullery and Mesnil 1897 (1 ; figures). (See p. 248.)  
 Pl. XXXIX, fig. 36 ; Pl. XL, fig. 27 ; Pl. XLII, figs. 30-34.  
 Northern waters, Gulf of St. Lawrence, Grand Banks of Newfoundland to Greenland, on stones and shells (*Chlamys islandicus*) ; Birterbuy Bay, Ireland, on limpet shells.
1797. *S. SULCATUS* \* Adams + Mörch 1863 (in synonymy). (See p. 249.)  
*granulatus* Montagu 1803 *non* Linné 1767.  
 Pl. XLI, fig. 9 ; Pl. XLIII, figs. 8, 19.  
 England, on shells.
1800. *S. TRANSVERSUS* Daudin (figures) + Mörch 1863.  
 Indian Ocean, on marine plants and shells.
1802. *S. COMMUNIS* Bosc (figures) + Mörch 1863, *non* Chenu + Fleming 1825.  
 (See p. 248.)  
 Open ocean, on *Fucus*.
1803. *S. CARINATUS* Montagu + Mörch 1863, *non* Lamarck 1818 + Levinsen 1883. (See p. 249.)  
 England, on stones and shells (*Ostrea*, *Pinna*, *Trochus*, *Arca*, etc.).
1803. *S. CORRUGATUS* \* Montagu + Mörch 1863 + Saint-Joseph 1894 *non* Langerhans 1880 (figures) + Caullery and Mesnil 1897 (7 ; figures). (See p. 248.)  
 England and Ireland, very common on stones and shells, with *Lepralia*.
1803. *S. HETEROSTROPHUS* \* Montagu (figure) + Mörch 1863. (See p. 248.)  
 England and Ireland, on stones and shells, with *Lepralia*.
1803. *S. SINISTRORSUS* \* Montagu + Mörch 1863 (in synonymy) + Chenu (figure). (See p. 251.)  
 England, on lobsters.
1803. *S. MINUTUS* Montagu + Mörch 1863. (See p. 248.)  
 England, on calcareous alga (*Corallina officinalis*).

1808. *S. PLICATUS* Montfort + Mörch 1863.<sup>1</sup>

*Serpula rugosa* Chenu (figures) *non* Turton.

Mediterranean, very common on algæ, crustaceans, etc.

1818. *S. TRICOSTALIS* Lamarck + Mörch 1863 + Chenu (figure).

King George Sound (Port Rio Georges), western Australia.

1818. *S. LAMELLOSUS* Lamarck + Mörch 1863 + Chenu (figure).

King's Island, Australia.

1822. *S. VERRUCA* \* Fabricius + Mörch 1863 *non* Levinsen 1883 (figures) + Caullery and Mesnil 1897 (17) + Moore 1902. (See p. 247.)

Pl. XLI, figs. 3, 12; Pl. XLIV, figs. 1, 16.

Greenland, on shells (*Chlamys islandicus*), and Grand Banks of Newfoundland, on stones.

1825. *S. MONTAGUI* Fleming + Mörch 1863.

*Spirorbis* sp. Montagu 1803.

Guernsey, England, on shell (*Haliotis tuberculata*), very common.

1830. *S. ANTARCTICUS* Lesson (figure) + Mörch 1863 + Chenu (figure).

Isle of Malouines, very common.

- 1830 and 1841. *S. PONTICUS* Eichwald (figure) + Mörch 1863.

Black Sea, on *Fucus* and other algæ.

1836. *S. PUSILLUS* Rathke + Mörch 1863 *non* Saint-Joseph 1894 + Caullery and Mesnil 1897 (9).

Black Sea, near Balaklava, on stones and shells (*Mytilus*).

1843. *S. ZELANDICUS* Gray + Mörch 1863.

Great Barrier Island, New Zealand, on shell (*Patella hookeri*).

1844. *S. CORNUARIETIS* \* Philippi (figure) + Mörch 1863 + Marion and Bobretzki 1875 (figures) + Caullery and Mesnil 1897 (20).

Mediterranean, English Channel (coast of France), on stones and coralline (*Lithothamnion polymorphum*).

1849. *S. CHILENSIS* Gay + Mörch 1863 (figure, Sowerby Ill. *Fissurella*) + Ehlers 1901.

Chili.

1853. *S. QUADRANGULARIS* \* Stimpson + Mörch 1863. (See p. 241.)

*fabricii* Malmgren 1867.

*carinatus* Levinsen 1883 (figures) *non* Montagu 1803.

*affinis* Levinsen 1883 (figure) + 1886.

*granulatus* Caullery and Mesnil 1897, in part, + Moore 1902.

Pl. XXXIX, fig. 37; Pl. XL, figs. 10, 11, 21, 23, 26, 30; Pl. XLII, figs. 23-29; Pl. XLIII, figs. 14, 15.

Northern waters, Atlantic and Pacific, on stones, shells (*Chlamys islandicus*, *Buccinum*, etc.), bryozoans, and worm tubes (*Nothria*, *Thelepus*,

<sup>1</sup>This and other species said to be in the Museum of Paris and figured by Chenu, 'Illustrationes de Conchyliologie,' do not appear to have been mentioned by Caullery and Mesnil 1897.

- Crucigera*, etc.), from low water to 120 fathoms. Coast of New England, from Cape Cod, Massachusetts, to Bay of Fundy, Gulf of St. Lawrence; Grand Banks of Newfoundland, Greenland, and Alaska.
1860. *S. SIMPLEX* Grube + Mörch 1863.  
Mediterranean.
1863. *S. POROSUS* Mörch + Chenu (figure).  
Habitat?
1863. *S. INCISUS* Mörch.  
*carinatus* Lamarck 1818 + Chenu (figure) *non* Montagu 1803.  
King's Island, Australia.
1863. *S. ALBUS* Mörch + Chenu (figure).  
Sea of India.
1865. *S. PAGENSTECHERI* Quatrefages + ? Langerhans 1880 (figures) + ?  
Saint-Joseph 1894 + ? Caullery and Mesnil 1897 (8; figures).  
*spirillum* Pagenstecher 1862 *non* Linné 1760.  
Cette, Gulf of Lyons, Madeira, Mediterranean; England?
1865. *S. LÆVIS* Quatrefages (figures) + Claparède 1868 (figures) + Saint-Joseph 1894.  
Guettary, near Saint-Jean-du-Luz, Bay of Biscay.
1868. *S. MILITARIS* Claparède (figures) + Saint-Joseph 1894 + Caullery and Mesnil 1897 (24; figures).  
*granulatus* Langerhans 1880 (figures) (*teste* Caullery and Mesnil 1897) + ? Saint-Joseph 1894 *non* Linné 1767.  
France (English Channel), Madeira, Naples, on stones and coralline (*Lithothamnion*).
1874. *S. VALIDUS* \* Verrill. (See p. 249.)  
*verruca* Levensen 1883 (figures) + Caullery and Mesnil 1897 (17) + Moore 1902.  
Pl. XXXVII, figs. 5-8, 10; Pl. XLIV, figs. 11-14.  
Northern waters, on stones, shells (*Chlamys islandicus*, *Sipho*, *Buccinum*, etc.), and worm tubes (*Nothria*), from 25 to 67 fms.; La Have Bank, Halifax Harbor, Nova Scotia; Grand Banks of Newfoundland, and Greenland.
1879. *S. STIMPSONI* \* Verrill. (See p. 250.)  
*nautiloides* Stimpson 1853 + Verrill 1874 (figure) *non* Lamarck 1818.  
Pl. XXXIX, fig. 38; Pl. XL, fig. 29; Pl. XLIII, figs. 20-22.  
New England coast, from Eastport, Maine, Bay of Fundy, to Massachusetts Bay, on stones and shells, from 10 to 160 fathoms.
1879. *S. BENETI* Marion (figures) + Caullery and Mesnil 1897 (21).  
Marseilles, Gulf of Lyons, on crinoid (*Antedon phalangium*).
1883. *S. MÖRCHI* \* Levensen (figures) + Caullery and Mesnil 1897 (27). (See p. 240.)  
Pl. XXXVII, figs. 15, 24; Pl. XLI, figs. 15, 16, 21, 24, 25; Pl. XLIV, figs. 20, 21.  
Atlantic and Pacific; Grand Banks of Newfoundland and Greenland, on shells (*Chlamys islandicus*); Alaska, on worm tubes (*Crucigera*) and shells;

and Queen Charlotte Island, British Columbia, on shells (*Pachypoma gibberosum*).

1883. S. VIOLACEUS \* Levinsen (figures) + Caullery and Mesnil 1897 (3 ; figures). (See p. 242.)

*granulatus* Fabricius 1780 non Linné 1767.

Pl. XLI, figs. 1, 2 ; Pl. XLII, figs. 8-12.

Atlantic and Pacific ; Grand Banks of Newfoundland and Greenland, on stones and shells (*Chlamys islandicus*) ; Alaska, on worm tubes (*Crucigera*) and shells ; and Queen Charlotte Island, British Columbia, on shells (*Pachypoma gibberosum*).

1894. S. ARMORICANUS Saint-Joseph (figures) + Caullery and Mesnil 1897 (5 ; figures).

? *sinistrorsus* Montagu 1803, in part.

France, on lobsters.

1897. S. MARIONI \* Caullery and Mesnil (6 ; figures). (See p. 239.)

Pl. XXXIX, figs. 26, 27 ; Pl. XL, fig. 16.

La Paz, Lower California, to Mexico, on sea-urchins (*Cidaris thoursti*), shells (*Crucibulum*, *Barbatia*, *Callopoma*, etc.), and other hosts.

1897. S. AGGREGATUS Caullery and Mesnil (10 ; figures) + Ehlers 1901.

Patagonia, in masses.

1897. S. CLAPAREDEI Caullery and Mesnil (11 ; figures) + Ehlers 1901.

Patagonia, on algæ and shells (*Modiolarca*).

1897. S. MALARDI Caullery and Mesnil (12 ; figures).

St. Vaast-la-Hougue, France, on shells.

1897. S. PATAGONICUS Caullery and Mesnil (13 ; figures) + Ehlers 1901.

Patagonia, on nullipore.

1897. S. LEBRUNI Caullery and Mesnil (14 ; figures) + Ehlers 1900 + 1901.

Patagonia, on sea-urchins (*Goniocidaris canaliculata*) ; Puerto Toro, from 20 to 25 fathoms.

1897. S. LEVINSENI Caullery and Mesnil (15 ; figures) + Ehlers 1901.

Patagonia, Straits of Magellan.

1897. S. PERRIERI Caullery and Mesnil (16 ; figures) + Ehlers 1900 + 1901.

Patagonia, very abundant on sea-urchins (*Echinus margariticeus*, *Goniocidaris canaliculata*, etc.), on algæ (*Laminaria*, etc.), on shells (*Modiolarca fuegensis*, *Pecten flustris*, etc.) ; Punta Arenas, Puerto Churucca, from 20 fathoms, and Beagle Channel.

1897. S. MEDITERRANEUS Caullery and Mesnil (19 ; figures).

Mediterranean, on *Scrpula* tubes.

1897. S. KÖHLERI Caullery and Mesnil (22 ; figures).

Mediterranean, on bryozoans.



1897. S. BERNARDI Caullery and Mesnil (23 ; figures).  
 Probable origin Indian Ocean, on sea-urchin (*Cidaris metularia*).
1897. S. LANGERHANSI \* Caullery and Mesnil (26 ; figures). (See p. 240.)  
 Panama to Central America, on sea-urchins (*Cidaris thoursi*) and shells  
 (*Callofoma*, *Crucibulum*, *Barbatia*, etc.).
1900. S. NORDENSKJÖLDI Ehlers + 1901.  
 Punta Delgada, Patagonia.
1904. S. FORAMINOSUS \* Bush (figures). (See p. 250.)  
 Japan, on red algæ, in 34 fathoms.
1904. S. BELLULUS \* Bush (figures). (See p. 250.)  
 Japan, on pebbles and fragments of shells, in 63 to 75 fathoms.
1904. S. DORSATUS \* Bush. (See p. 250.)  
 Japan, on fragments of shells, in 63 to 75 fathoms.
1904. S. ARGUTUS \* Bush (figures). (See p. 251.)  
 Japan, on red algæ, in 34 fathoms.
1904. S. PSEUDOCORRUGATUS nom. nov. (See p. 250.)  
*corrugatus* Caullery and Mesnil 1897 (7 ; figures) + ? Langerhans  
 1880 *non* Montagu 1803.  
 Madeira and Gulf of Naples.
1904. S. PUSILLOIDES nom. nov. (See p. 250.)  
*pusillus* Saint-Joseph 1894 (figures) + Caullery and Mesnil 1897 (9 ;  
 figures) *non* Rathke 1836.  
 St.-Vaast-la-Hougue, France.
1904. S. SEMIDENTATUS \* sp. nov. (See p. 237.)  
 Pl. XXVII, figs. 7, 10 ; Pl. XLI, figs. 13, 17, 23, 26-30 ; Pl. XLIII, figs. 4,  
 5, 12.  
 Alaska (Sitka, Prince William Sound, and Unalaska Island), on rocks,  
 stones, and worm tubes (*Serpula* and *Crucigera*).
1904. S. VARIABILIS \* sp. nov. (See p. 238.)  
 Pl. XXIX, fig. 3, a ; Pl. XXXIX, figs. 24, 25 ; Pl. XL, fig. 4 ; Pl. XLIII,  
 fig. 16 ; Pl. XLIV, fig. 17.  
 Alaska (Sitka), on rocks and shells.
1904. S. EXIMIUS \* sp. nov. (See p. 239.)  
 Pl. XXXIX, fig. 9 ; Pl. XLI, figs. 7, 18, 20 ; Pl. XLIII, figs. 6, 11, 17.  
 California (Pacific Grove), on worm tube (*Serpula*).
1904. S. INCONGRUUS \* sp. nov. (See p. 241.)  
 Pl. XL, figs. 19, 20, 28.  
 Alaska (Prince William Sound), on worm tubes (*Serpula* and *Crucigera*).
1904. S. LINEATUS \* sp. nov. (See p. 242.)  
 Pl. XXXIX, fig. 29.  
 Alaska (Sitka and Prince William Sound), on shells and worm tubes.

1904. *S. SIMILIS* \* sp. nov. (See p. 242.)  
 Pl. XXIX, fig. 3, *c*; Pl. XXXIX, figs. 16, 31; Pl. XL, figs. 9, 17, 18; Pl. XLIII, figs. 27, 31.  
 Alaska (Prince William Sound), on worm tubes (*Crucigera*).
1904. *S. RUGATUS* \* sp. nov. (See p. 243.)  
 Pl. XXIX, fig. 3, *b*; Pl. XXXV, fig. 14; Pl. XLIV, figs. 18, 19.  
 Alaska (Sitka), on rocks.
1904. *S. COMPTUS* \* sp. nov. (See p. 244.)  
 California, on algæ.
1904. *S. ASPERATUS* \* sp. nov. (See p. 245.)  
 Pl. XXVIII, fig. 10; Pl. XXX, fig. 4; Pl. XLI, figs. 4, 5, 6, 8, 10, 11, 19, 31, 32; Pl. XLIII, figs. 1, 2, 3, 7, 13, 26.  
 California (Pacific Grove), Alaska (Sitka and Prince William Sound), on shells and worm tubes (*Crucigera*).
1904. *S. ABNORMIS* \* sp. nov. (See p. 245.)  
 Pl. XXXIX, fig. 35; Pl. XL, figs. 1, 2; Pl. XLIII, figs. 24, 28, 29.  
 Alaska (Sitka), on rocks.
1904. *S. INVERSUS* \* sp. nov. (See p. 246.)  
 Australia (Port Phillip, Victoria), on bryozoa (*Menipea cirrata*?).
1904. *S. TRIDENTATUS* \* sp. nov. (See p. 246.)  
 Australia (Port Phillip, Victoria), on bryozoa (*Menipea cirrata*?).
1904. *S. TUBÆFORMIS* \* sp. nov. (See p. 251.)  
 Pl. XXXIX, figs. 30, 32; Pl. XLII, figs. 13, 14.  
 Long Island Sound, on Irish moss (*Chondrus*).
1904. *S. EVOLUTUS* \* sp. nov. (See p. 251.)  
 Pl. XLII, figs. 20-22.  
 Grand Banks of Newfoundland, on shells (*Sipho*).
1904. *S. FORMOSUS* \* sp. nov. (See p. 252.)  
 Pl. XXXIX, figs. 18, 19; Pl. XLI, fig. 22; Pl. XLIII, figs. 18, 23, 25, 30.  
 Gulf Stream and Bermuda, on gulf-weed (*Sargassum*), etc.
1904. *S. MUTABILIS* \* sp. nov. (See p. 252.)  
 Bermuda, on shells.

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## ADDENDA.

The following notes, which with a few exceptions relate to forms previously mentioned, were made after the foregoing pages were set up, therefore too late to have them inserted in their proper places.

Genus **Metalaonome** nov. (See pp. 178 and 192.)

Branchial lobes elongated ventrally and spirally coiled only in retraction. Interbranchial membrane inconspicuous or wanting. Collar four-lobed, with ends widely separated on the back. Superior setæ and inferior collar setæ regularly tapered blades; inferior setæ back of collar, short ob lanceolate. Avicular uncini only in all the tori of the body.

Lo Bianco (1893) described the species *Bispira mariæ* as having the elongated branchial lobes forming spirals of two or three turns, but in the figure he has represented them as simple, similar to those of *Sabella*, so that probably, like species of that genus, this one has them spiral only in retraction. The branchiæ, numbering between 80 and 90, are very long (about one half as long as body) and slender, with seven series of dark color spots forming bands.

The body is short and stout, of about 80 segments, of which 8 belong to the thorax.

The collar is four-lobed, open on back with widely separated ends. Setæ on the collar and superior setæ on the other thoracic segments very narrow, regularly tapered blades; inferior setæ back of collar, short and broad ob lanceolate. Avicular uncini only in all the tori of the body.

Genera **Schizocraspedon** and **Glossopsis** nov. (See pp. 179 and 225.)

Grube (1878) placed his two new species *H. furcifera* and *H. minax* in the genus *Hydroides*, with which they have strong affinities, but the very remarkable development of the opercula, described on p. 225, would at once distinguish them from typical species of that genus; hence they have been respectively referred to the two new genera *Schizocraspedon* and *Glossopsis*.

Genus **Protoplacostegus** nov. (See pp. 179 and 226.)

McIntosh (1885) described and figured his species *Placostegus mörchii* as having a primary, somewhat cup-shaped operculum with horny plate on the end of one branchia and an undeveloped secondary one on the end of another branchia. The setæ short and broad at base with tapered blades (no collar setæ were found). Uncini with few (6

or 7) serrations, the lowest large and fang-like. As all of these characters differ greatly from those of *Placostegus tridentatus*, the type of the genus *Placostegus* (p. 221), the new genus *Protoplacostegus* is therefore proposed for McIntosh's species.

Genus *Spirorbis* Daudin. (See p. 247.)

On several specimens of *Margaritifera*, recently received from Beirut, Syria, are numerous tubes of three species of *Spirorbis*. One sinistral form is moderately large, regularly coiled, the surface more or less roughened by irregular concentric growth lines but with no distinct sculpture. The animals examined have a calcareous plate in the operculum, shallow, oblique, cup-shaped with broad, short base, with a conspicuous spine at the back, not differing from that figured by Marion and Bobretzky (1875) for *Spirorbis cornuarietis* of Philippi. The collar setæ have coarsely serrate tapered blades with coarse fin-like bases. On comparing this with the figure given by Philippi (1844) there was found a decided difference in the size and position of the basal spine, that of Philippi's species being figured as on the front just below the deepest part of the cup, while in the present form and in that figured by Marion and Bobretzky the spine is at the back and rudder-like in form. Philippi also described his species as having the tube concentrically striated, so that there may be some confusion in the identification of the species, and that described and figured by Marion and Bobretzky may be distinct. If, however, upon further study it proves to be the same as Philippi's, this species is erroneously placed in the table on p. 260 and should be transferred to the first group with species whose tubes are unsculptured, the growth lines not being treated as such.

Another animal has the calcareous plate of the operculum composed of two distinct pieces. The end one is a similar, oblique, shallow cup with spreading base, which has an elongated, narrow, median portion thickened along its back, forming three conspicuous serrations; posterior to and in front of the base of this end piece is a large concavo-convex, shield-shaped one which is entirely detached from it and is very unlike the comparatively thin, firm, elongated, shield-shaped protection wall found in the opercula which form brood-pouches. The collar setæ are coarsely serrate with basal fin. The tube is sinistral, of good size, with the surface roughened by faint spiral threads and irregular growth lines. Smaller dextral tubes have the surface ornamented with definite spiral threads crossed by distinct concentric lines. The animal has but a simple calcareous disk in the operculum and the

collar setæ have angular tapered blades. As the article on *Spirorbis*, by Caullery and Mesnil, could not be consulted, these two species could not be identified. The first may be *S. beneti* Marion 1875.

In the posterior segments of one animal of *Spirorbis mutabilis* were clusters of spermatogonia and isolated spermatozoa, also good-sized eggs with large nuclei, this being the only instance noted among the many animals studied. (See pp. 252 and 255.)

Genus **Rhodopsis** nov. (See pp. 179 and 223.)

Tube small, calcareous, hair-like, more or less sigmoid, usually attached its entire length to the under surface of the common hat-coral (*Agaricia fragilis*) from Bermuda.

Animal minute, deep yellow, with the operculum protected by a disproportionately large, chitinous disk covered with numerous unequal irregular light horn-colored processes or spines arranged in the form of a rosette — hence the name.

Branchiæ not determined, appearing as a mass back of the operculum, in the six specimens examined.

Eyes two, conspicuous red, showing beneath the collar.

Thorax short, the segments defined on each side by the 6, in one instance 5, small fascicles of setæ at the end of the 6 series of uncini, there being no separate fascicle on the collar. Body cavity elongated, showing dark brown intestinal tract. Posterior portion usually mutilated; when perfect, ornamented along the dorsal (?) area by long irregular ribbon-like appendages somewhat resembling the spines on the operculum; the elongated segments (about 5) defined on the opposite (ventral ?) area by transverse lines, a series of uncini on the middle of each; but no setæ were seen.

Thoracic setæ bent at the base of the broad abruptly tapered blade. Uncial plates (seen in profile) similar to those of *Filograna*, with about ten rather blunt appressed teeth, the lowest larger than the others; seen in front the broad tapered face has several alternating rows of minute pointed teeth. On the abdomen the uncini were seen only in a front view; the face is broad, of uniform width, and no serrations could be made out even with the  $\frac{1}{10}$  oil immersion objective.

**Rhodopsis pusillus** sp. nov. (See pp. 179 and 223.)

*Type locality.* — Bermuda.

Numerous small round tubes of uniform diameter, with both ends open, resembling fine wavy white hairs are found scattered over the under surface of the common hat-coral (*Agaricia fragilis*).



They are more or less sigmoid, either isolated or in masses, usually attached their entire length but when too crowded lifting themselves outward, forming a free end. Their surface is roughened by unequal concentric growth lines and they are opaque except for a very small semitransparent portion which in dried specimens is usually about the middle, revealing the position of the minute yellow animal.

Length varying from 5-8 mm.; diameter about  $\frac{1}{8}$  mm.

These tubes were supposed to belong to some species of *Filograna*; the animals, however, after treatment with potash solution, were found to differ from those of that genus in possessing an operculum. This is remarkable for the form, size, and arrangement of the spine-like processes covering the thin chitinous disk which protects its end. They are long, blunt, light horn-color, differ greatly in size and form, and appear to be arranged in three alternating series forming a rosette; those of the outer and middle series being very irregular in outline, differing greatly in number and position of the irregularities; those of the inner series more numerous (about 24), smaller, simple, tapered and obliquely truncated.

No setæ were found on the collar, which is apparently without incisions or clefts, shallow across the back, deep along the sides and in front with angular dorso-lateral corners.

Thoracic segments defined only by the 5 or 6 series of uncini and small fascicles of setæ. Abdomen with uncini only, apparently arranged in a single series, along the median area. The surface on the opposite portion of the body covered with long unequal ribbon-like processes resembling in form the spine-like ones on the opercular plate.

Length of the largest perfect animal  $\frac{3}{8}$  mm.

Genus **Josephella** Caullery and Mesnil (?). (See p. 226.)

Tubes similar to those given above as belonging to *Rhodopsis pusillus* from Bermuda were found on *Margaritifera* from Beirut, Syria, but the animal is very dissimilar, being elongated with a simple operculum on which the chitinous plate has a deep erect transparent rim strengthened on its upper surface by long, tapered spine-like processes often with secondary spinules. There are 5 thoracic fascicles of tapered setæ and 4 series of uncini; on the following segments the tori with a few uncini and one very slender tapered seta are well separated along the middle region of the body, but more crowded posteriorly; the caudal portion was not found. The setæ below the collar fascicle are bent at the base of the blade and the uncini have a com-



paratively few unequal serrations the lowest one long and fang-like when seen in profile, but in a front view the broad surface has three or four alternating series of slender teeth. With the exception of the operculum these characters seem to agree with those of *Josephella marenzelleri* Caullery and Mesnil (p. 226); the operculum is described by these authors as being borne on the end of a branchia and as having some calcareous deposit; the Mediterranean species may be immature and a fully developed operculum might have some lime deposit. The tube recalls that of *Filograna*, one species of which (*F. corallifica* Pallas 1766) is given by Mörch, 1863, as from the Mediterranean; since no further mention has been found of any similar form, the species, notwithstanding the fact that the operculum appears also to differ in having a definite peduncle, is referred to *Josephella*, as *J. humilis*, but with considerable doubt.

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PLATE XXI.

- FIG. 1. *Eudistylia gigantea* sp. nov., p. 210. Lateral view,  $\times \frac{1}{4}$ .  
2. Opposite view of same specimen.  
3. *Eudistylia plumosa* sp. nov., p. 212. Ventral view of anterior portion of type, slightly enlarged.  
4. Lateral view of same specimen, about natural size.

(300)







## PLATE XXII.

- FIG. 1. *Myxicola glacialis* sp. nov., p. 218. Lateral view of long slender form,  
 $\times \frac{3}{2}$ .
2. *Eudistylia tenella* sp. nov., p. 213. Ventral view,  $\times \frac{3}{2}$ .
3. Opposite view of same specimen.
4. Branchiæ: *a*, *Eudistylia gigantea* sp. nov., p. 210, showing double end;  
*b*, *Eudistylia plumosa* sp. nov., p. 212; *c*, *Eudistylia gigantea*, normal;  
*d*, *Eudistylia gigantea*, medium sized specimen; all  $\times 3$ .



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PLATE XXIII.

- FIG. 1. *Eudistylia gigantea* sp. nov., p. 210. Dorsal view of anterior portion of a medium sized specimen,  $\times 1$ .
2. *Schizobranchia concinna* sp. nov., p. 208. Dorsal view of type,  $\times \frac{3}{2}$ .
3. Ventral view of same specimen.
4. *Eudistylia tenella* sp. nov., p. 213. Dorsal view of anterior portion of a medium sized specimen,  $\times \frac{3}{2}$ .
5. Lateral view of same specimen.



ANNELOID





PLATE XXIV.

- FIG. 1. *Schizobranchia insignis* sp. nov., p. 206. Ventral view,  $\times 1$ .  
2. Dorsal view of another specimen.  
3. *Schizobranchia nobilis* sp. nov., p. 207. Ventral view,  $\times 1$ .  
4. *Eudistylia abbreviata* sp. nov., p. 212. Lateral view,  $\times 1$ .



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PLATE XXV.

- FIG. 1. *Myxicola glacialis* sp. nov., p. 218. Lateral view,  $\times 3$ .  
2. Lateral view of another specimen.  
3. *Aspeira modesta* sp. nov., p. 202. Dorsal view,  $\times \frac{5}{2}$ .  
4. *Eudistylia gigantea* sp. nov., p. 210. Ventral view of a medium sized specimen,  $\times 1$ .  
5. *Crucigera irregularis* sp. nov., p. 234. Lateral view,  $\times 3$ .



ANNELETS

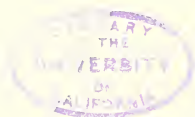




PLATE XXVI.

- FIG. 1. *Myxicola conjuncta* sp. nov., p. 217. Lateral view, slightly enlarged.  
2. *Sabella elegans* sp. nov., p. 194. Lateral view,  $\times 3$ .  
3. *Serpula splendens* sp. nov., p. 230. Ventral view of anterior portion,  
 $\times 4$ .  
4. Branchiæ: *a*, *Myxicola conjuncta* sp. nov., p. 217; *b*, *Myxicola glacialis*  
sp. nov., p. 218; both  $\times 5$ .

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3

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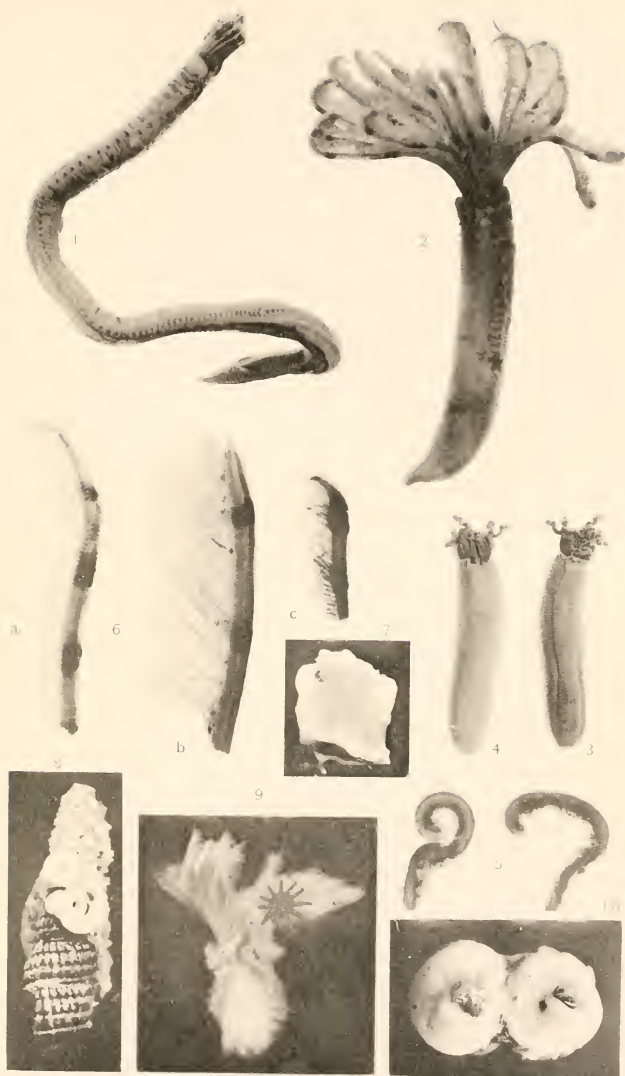






## PLATE XXVII.

- FIG. 1. *Schizobranchia insignis* sp. nov., p. 206. Lateral view of young specimen in which the branchiæ are being repaired from injury,  $\times 2$ .
2. *Sabella humilis* sp. nov., p. 195. Dorso-lateral view,  $\times$  about 4.
3. *Parasabella media* sp. nov., p. 200. Ventral view,  $\times \frac{3}{2}$ .
4. Dorsal view of same specimen.
5. Portion of two branchiæ,  $\times 4$ .
6. Terminal portions of branchiæ,  $\times 6$ : a, *Sabella leptalea* sp. nov., p. 195; b, *Sabella formosa* sp. nov., p. 196; c, *Sabella elegans* sp. nov., p. 194.
7. *Spirorbis semidentatus* sp. nov., p. 237. Lateral view of tube, showing operculum,  $\times 5$ .
8. *Spirorbis spirillum* Linné var. *lucidus* Montagu, p. 243, from Pacific Grove, on shell of *Cerithium*,  $\times 5$ .
9. *Eupomatus gracilis* sp. nov., p. 234. Dorsal view of anterior portion of specimen from Pacific Grove,  $\times 4$ .
10. *Spirorbis semidentatus* sp. nov., p. 237. Top view of two tubes, showing slightly protruding animal,  $\times 5$ .



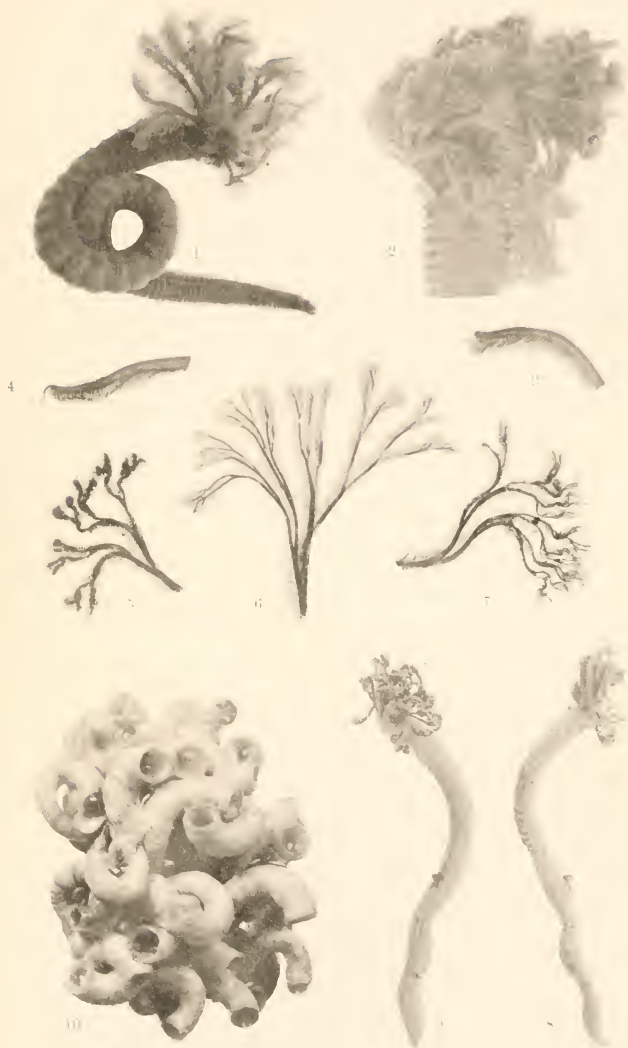
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## PLATE XXVIII.

- FIG. 1. *Schizobranchia dubia* sp. nov., p. 208. Lateral view,  $\times$  3.  
2. *Schizobranchia concinna* sp. nov., p. 208. Dorsal view of anterior portions of a medium sized specimen,  $\times$  about 3.  
3. *Crucigera formosa* sp. nov., p. 233. Branchia without terminal filament,  $\times$  5.  
4. Another branchia with short terminal filament,  $\times$  about 2.  
5. *Schizobranchia insignis* sp. nov., p. 206. Branchia,  $\times$  about 2.  
6. *Schizobranchia concinna* sp. nov., p. 208. Branchia,  $\times$  about 2.  
7. *Schizobranchia nobilis* sp. nov., p. 207. Branchia,  $\times$  about 2.  
8. *Parasabella maculata* sp. nov., p. 201. Lateral view,  $\times$  about 2.  
9. Ventral view of same specimen.  
10. *Spirorbis asperatus* sp. nov., p. 245. Mass of tubes,  $\times$  about 6.



ALCYONACEA

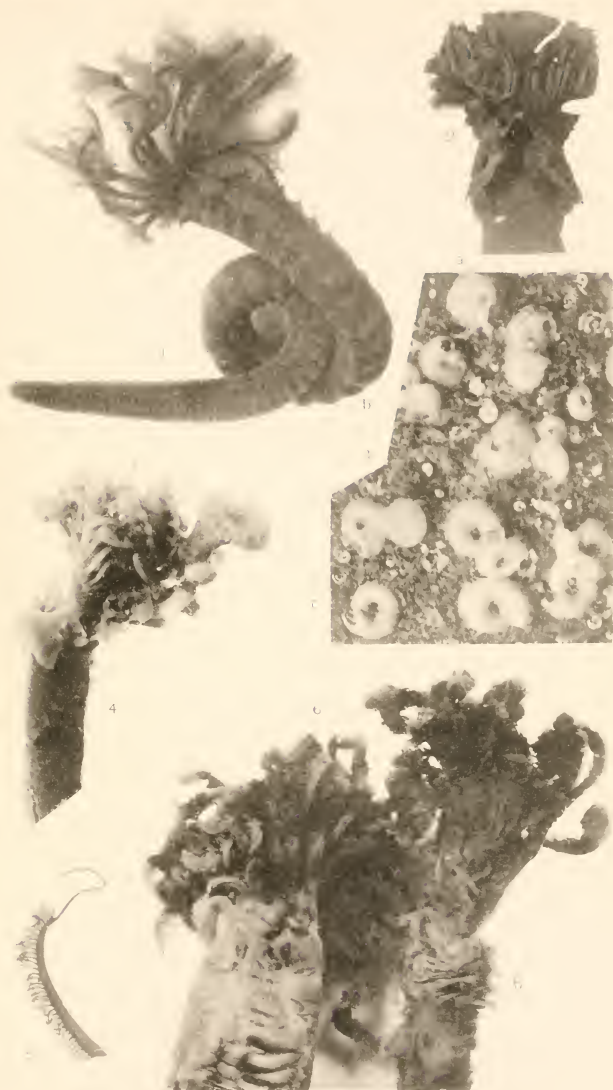






## PLATE XXIX.

- FIG. 1. *Schizobranchia dubia* sp. nov., p. 208. Dorso-lateral view,  $\times 5$ .
2. *Serpula splendens* sp. nov., p. 230. Dorsal view of anterior portion, showing both primary and secondary operculum,  $\times 2$ .
3. A piece of stone covered with tubes of *Spirorbis*,  $\times$  about 4: *a*, Sinistral, vitreous, *Spirorbis variabilis* sp. nov., p. 238; *b*, Dextral, *Spirorbis rugatus* sp. nov., p. 243; *c*, Sinistral, nonglassy, *Spirorbis similis* sp. nov., p. 242.
4. *Crucigera irregularis* sp. nov., p. 234. Lateral view of anterior portion of type,  $\times 3$ .
5. *Crucigera zygothora* (Johnson), p. 233. Branchia,  $\times 5$ .
6. *Eudistylia polymorpha* (Johnson), p. 214. Anterior portion of specimen from Victoria, British Columbia,  $\times 4$ : *a*, cut dorso-ventrally, to show the spiral branchial lobe; *b*, the other half cut laterally, to show height of spiral with branchial membrane.



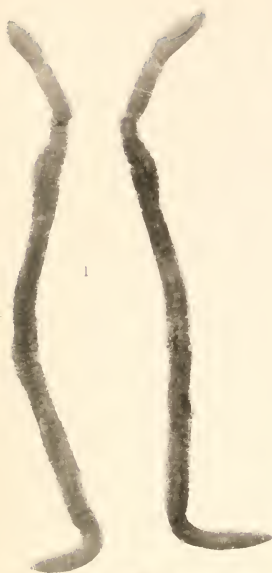
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PLATE XXX.

- FIG. 1. *Chone teres* sp. nov., p. 215. Two views of the type,  $\times 2$ .
2. *Serpula splendens* sp. nov., p. 230. Lateral view of a specimen, showing a portion of the tube covered with tubes of *Spirorbis* and *Hyalopomatopsis*,  $\times 2$ .
3. Opposite view of another specimen,  $\times 2$ .
4. *Spirorbis asperatus* sp. nov., p. 245. Mass of tubes of the variety with roughened surface, attached to a gastropod shell,  $\times$  about 6.



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PLATE XXXI.

- FIG. 1. *Crucigera formosa* sp. nov., p. 233. Dorso-lateral view of type,  $\times 3$ .  
2. *Crucigera zygophora* (Johnson), p. 233. A mass of tubes with their animals,  $\times 2$ .

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1



2

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## PLATE XXXII.

- FIG. 1. *Eudistylia gigantea* sp. nov., p. 210. Seta from abdomen, about  $\frac{3}{4}$  view.  
 2. Pennoned seta, from a thoracic torus of another specimen, back view.  
 3. Inferior thoracic seta below the collar, from the same specimen as fig. 11, about  $\frac{3}{4}$  view.  
 4. Inferior seta from the collar fascicle of the same specimen as fig. 1, about  $\frac{3}{4}$  view.  
 5. Another seta from the same fascicle, more turned.  
 6. Inferior seta from collar fascicle of type, nearly back view.  
 7. Superior seta from the same fascicle, side view.  
 8. Inferior thoracic seta below collar of type, back view.  
 9. *Eudistylia plumosa* sp. nov., p. 212. Inferior thoracic seta below collar of type, nearly back view.  
 10. *Eudistylia gigantea* sp. nov., p. 210. Seta from abdomen of type.  
 11. Inferior thoracic seta from the same specimen as fig. 3.  
 12. Avicular uncinus from a caudal torus of type.  
 13. Avicular uncinus from a thoracic torus of type.  
 14. Pennoned seta from same torus, in profile.  
 15. *Eudistylia plumosa* sp. nov., p. 212. Avicular uncinus from near ventral end of a thoracic torus of type.  
 16. *Eudistylia gigantea* sp. nov., p. 210. Avicular uncinus from thoracic torus from the same specimen as fig. 1.  
 17. Pennoned seta from same torus, in profile.  
 18. *Eudistylia plumosa* sp. nov., p. 212. Avicular uncinus from abdominal torus of type.  
 19. Seta from abdomen of type.  
 20. Superior seta from fourth thoracic segment of type.  
 21. *Eudistylia gigantea* sp. nov., p. 210. Avicular uncinus from abdominal torus of type.  
 22. *Eudistylia plumosa* sp. nov., p. 212. Avicular uncinus near dorsal end of same thoracic torus as fig. 15.  
 23. *Eudistylia gigantea* sp. nov., p. 210. Pennoned seta from a thoracic torus of same specimen as fig. 2, another view.  
 24. Avicular uncinus from abdominal torus of same specimen as fig. 1.  
 25. Inferior thoracic seta below collar of same specimen as fig. 2.  
 26. Superior seta from fourth thoracic segment of type.

Figures 1, 4, 5, 6, 7, 9, 10, 19, 20 are by A. H. Verrill,  $\times 196$ ; the others, by the author,  $\times 212$ .



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# PLATE XXXIII.

- FIG. 1. *Eudistylia abbreviata* sp. nov., p. 212. Inferior seta from collar fascicle, nearly back view.
2. Superior seta from the same fascicle, in profile.
3. *Crucigera zygophora* (Johnson), p. 233. Posterior portion of a collar seta.
4. *Crucigera formosa* sp. nov., p. 233. Posterior portion of a collar seta, about  $\frac{3}{4}$  view.
5. *Sabella leptalea* sp. nov., p. 195. Avicular uncinus from thoracic torus.
6. *Pseudopotamilla oculifera* (Leidy), p. 204. Pennoned seta from thoracic torus.
7. *Schizobranchia dubia* sp. nov., p. 208. Pennoned seta from thoracic torus.
8. *Parasabella maculata* sp. nov., p. 201. Seta from collar fascicle, in profile.
9. *Schizobranchia affinis* sp. nov., p. 209. Inferior thoracic seta below collar fascicle, about  $\frac{3}{4}$  view.
10. *Eudistylia abbreviata* sp. nov., p. 212. Seta from abdomen, back view.
11. *Schizobranchia affinis* sp. nov., p. 209. Inferior seta from same fascicle as fig. 9, different position.
12. *Parasabella maculata* sp. nov., p. 201. Inferior seta from fourth thoracic segment, about  $\frac{3}{4}$  view.
13. *Crucigera irregularis* sp. nov., p. 234. Posterior portion of a collar seta.
14. *Sabella leptalea* sp. nov., p. 195. Avicular uncinus from abdominal torus.
15. *Spirorbis spirillum* (Linné) var. *lucidus* (Montagu), p. 243. Calcareous plate from operculum.
16. *Eudistylia tenella* sp. nov., p. 213. Pennoned seta from thoracic torus.
17. *Schizobranchia affinis* sp. nov., p. 209. Avicular uncinus from thoracic torus.
18. *Eudistylia abbreviata* sp. nov., p. 212. Pennoned seta from thoracic torus.
19. *Eudistylia tenella* sp. nov., p. 213. Avicular uncinus from abdominal torus.
20. *Sabella elegans* sp. nov., p. 194. Avicular uncinus from thoracic torus.
21. Avicular uncinus from abdominal torus.
22. *Schizobranchia nobilis* sp. nov., p. 207. Avicular uncinus from thoracic torus of a young specimen from Dutch Harbor.
23. *Schizobranchia affinis* sp. nov., p. 209. Seta from abdomen, back view.
24. *Eudistylia tenella* sp. nov., p. 213. Inferior thoracic seta below collar.
25. *Eudistylia abbreviata* sp. nov., p. 212. Inferior thoracic seta below collar.



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PLATE XXXIII—*Continued.*

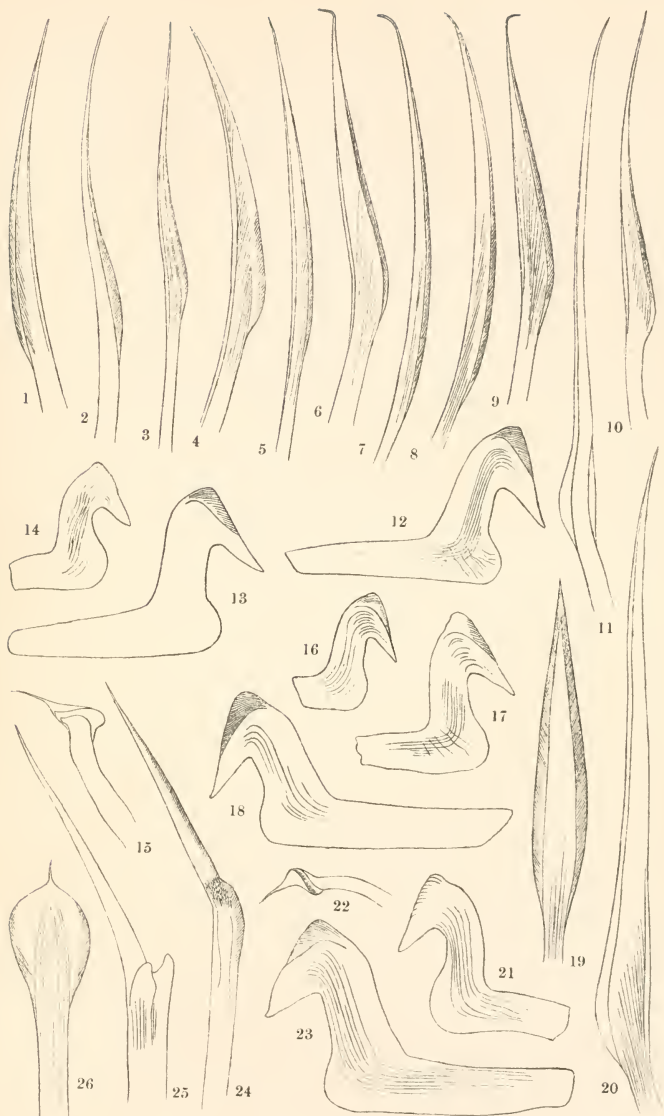
- FIG. 26. *Eudistylia intermedia* sp. nov., p. 214. Avicular uncinus from abdominal torus of specimen from Pacific Grove, California.
27. *Sabella leptalea* sp. nov., p. 195. Pennoned seta from a thoracic torus.
28. *Eudistylia intermedia* sp. nov. Pennoned seta from thoracic torus.
29. *Sabella leptalea* sp. nov. Pennoned seta from a thoracic torus, different position from fig. 27.
30. *Pseudopotamilla oculifera* (Leidy), p. 204. Pennoned seta from thoracic torus, different position from fig. 6.
31. *Serpula splendens* sp. nov., p. 230. Posterior portion of seta from collar fascicle.
32. *Sabella formosa* sp. nov., p. 196. Pennoned seta from thoracic torus.
33. *Parasabella maculata* sp. nov., p. 201. Inferior seta from same thoracic segment as fig. 12, different view.
34. *Parasabella media* sp. nov., p. 200. Seta from collar fascicle, about  $\frac{3}{4}$  view.
35. Inferior seta from fourth thoracic segment, back view.
36. Superior seta from same fascicle, in profile.

Figures 1, 2, 21, 23, 25, 34, 35, 36 are by A. H. Verrill,  $\times$  222. The others, by the author,  $\times$  230, except figure 15,  $\times$  37.

# PLATE XXXIV.

- FIG. 1. *Sabella elegans* sp. nov., p. 194. Seta from collar fascicle, nearly back view.
2. *Parasabella maculata* sp. nov., p. 201. Superior seta from fourth thoracic fascicle, in profile.
3. *Parasabella media* sp. nov., p. 200. Seta from abdomen.
4. *Sabella elegans* sp. nov., p. 194. Inferior seta from fourth thoracic fascicle.
5. Superior seta from same fascicle.
6. *Sabella leptalea* sp. nov., p. 195. Seta from abdomen.
7. Seta from collar fascicle.
8. Superior seta from fourth thoracic fascicle.
9. Inferior seta from same fascicle.
10. *Sabella elegans* sp. nov., p. 194. Seta from abdomen.
11. *Pseudopotamilla oculifera* (Leidy), p. 204. Seta from abdomen, back view.
12. *Eudistylia tenella* sp. nov., p. 213. Avicular uncinus from a thoracic torus.
13. *Eudistylia abbreviata* sp. nov., p. 212. Avicular uncinus from a thoracic torus.
14. *Sabella formosa* sp. nov., p. 196. Avicular uncinus from an abdominal torus.
15. *Schizobranchia concinna* sp. nov., p. 208. Pennoned seta from a thoracic torus.
16. *Eudistylia abbreviata* sp. nov., p. 212. Avicular uncinus from an abdominal torus.
17. *Schizobranchia concinna* sp. nov., p. 208. Avicular uncinus from abdominal torus.
18. Avicular uncinus from thoracic torus, slightly turned.
19. *Eudistylia intermedia* sp. nov., p. 214. Inferior seta from collar fascicle, back view.
20. Seta from abdomen.
21. *Sabella formosa* sp. nov., p. 196. Avicular uncinus from a thoracic torus.
22. *Sabella leptalea* sp. nov., p. 195. Pennoned seta from a thoracic torus.
23. *Eudistylia gigantea* sp. nov., p. 210. Avicular uncinus from a thoracic torus, slightly turned.
24. *Spirobranchus incrassatus* (Kröyer), p. 236. Seta from collar fascicle of specimen from Central America.
25. *Eupomatus gracilis* sp. nov., p. 234. Seta from collar fascicle of type from Pacific Grove, California.
26. *Eudistylia intermedia* sp. nov., p. 214. Inferior seta from a thoracic fascicle below collar.

Figures 1, 3-10, 14, 19, 21 are by A. H. Verrill, X 196. The others, by the author, X 212.



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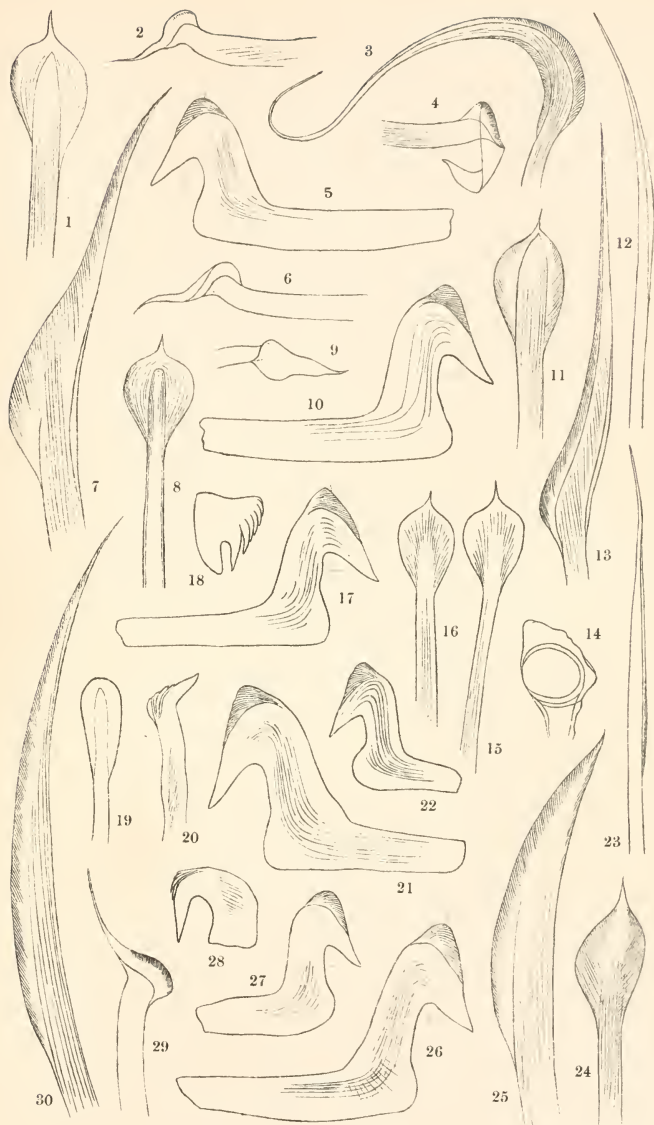




# PLATE XXV.

- FIG. 1. *Schizobranchia nobilis* sp. nov., p. 207. Inferior thoracic seta below collar, of type.
2. *Schizobranchia insignis* sp. nov., p. 206. Pennoned seta from thoracic torus of type.
3. *Schizobranchia nobilis* sp. nov., p. 207. Seta from abdomen of type.
4. Pennoned seta from thoracic torus of type.
5. Avicular uncinus from thoracic torus of another specimen.
6. Pennoned seta from same thoracic torus.
7. *Sabella formosa* sp. nov., p. 196. Seta from abdomen.
8. *Schizobranchia nobilis* sp. nov., p. 207. Inferior seta from thorax of type.
9. *Schizobranchia affinis* sp. nov., p. 209. Pennoned seta from thoracic torus, front view.
10. *Schizobranchia nobilis* sp. nov., 207. Avicular uncinus from thoracic torus of type.
11. Inferior thoracic seta from same specimen as fig. 5.
12. *Schizobranchia insignis* sp. nov., p. 206. Superior thoracic seta below collar, same specimen as fig. 2.
13. Seta from abdomen of same specimen.
14. *Spirorbis rugatus* sp. nov., p. 243. Operculum torn away, showing calcareous disk at base.
15. *Schizobranchia insignis* sp. nov., p. 206. Inferior thoracic seta from same specimen as fig. 2.
16. Another inferior seta from same specimen.
17. *Schizobranchia concinna* sp. nov., p. 208. Avicular uncinus from thoracic torus.
18. *Serpula splendens* sp. nov., p. 230. Uncinus from thorax.
19. *Metachone mollis* sp. nov., p. 216. Clavate seta from thorax of type, from Pacific Grove, California.
20. Beaked seta from thorax of same specimen.
21. *Eudistylia intermedia* sp. nov., p. 214. Avicular uncinus from thoracic torus of type.
22. *Eudistylia tenella* sp. nov., p. 213. Avicular uncinus from abdominal torus.
23. *Schizobranchia nobilis* sp. nov., p. 207. Superior seta from collar fascicle.
24. *Schizobranchia concinna* sp. nov., p. 208. Inferior thoracic seta below collar fascicle.
25. *Sabella formosa* sp. nov., p. 196. Inferior seta from thorax of same specimen as fig. 7.
26. *Schizobranchia insignis* sp. nov., p. 206. Avicular uncinus from thoracic torus of same specimen as fig. 2.
27. Avicular uncinus from abdominal torus of same specimen.
28. *Metachone mollis* sp. nov., p. 216. Uncinus from abdomen of type.
29. *Eudistylia intermedia* sp. nov., p. 214. Pennoned seta from same torus as fig. 21.
30. *Sabella formosa* sp. nov., p. 196. Superior seta from thorax of same fascicle as fig. 25.

Figures 3, 7, 8, 12, 13, 15, 16, 23, 24, 25, 30 by A. H. Verrill,  $\times 196$ ; the others, by the author,  $\times 212$ , except figure 14,  $\times 35$ .



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# PLATE XXXVI.

- FIG. 1. *Schizobanchia dubia* sp. nov., p. 208. Pennoned seta from thoracic torus, back view.
2. Avicular uncinus from same torus.
  3. Another pennoned seta from thorax, nearly side view.
  4. *Sabella humilis* sp. nov., p. 195. Seta from collar fascicle of type.
  5. Another seta from collar fascicle.
  6. Seta from fourth thoracic fascicle.
  7. Pennoned seta from a thoracic torus.
  8. Avicular uncinus from an abdominal torus, in profile.
  9. Another from same torus, nearly front view.
  10. Avicular uncinus from thoracic torus.
  11. Pennoned seta from thoracic torus.
  12. *Parasabella maculata* sp. nov., p. 201. Avicular uncinus from an abdominal torus.
  13. *Parasabella media* sp. nov., p. 200. Avicular uncinus from a thoracic torus.
  14. Pennoned seta from a thoracic torus (no potash used).
  15. *Parasabella maculata* sp. nov., p. 201. Pennoned seta from a thoracic torus.
  16. Avicular uncinus from a thoracic torus.
  17. *Schizobanchia dubia* sp. nov., p. 208. One of the shorter or inferior setæ from collar fascicle, back view.
  18. Seta from the abdomen, back view.
  19. One of the longer or superior setæ from the collar fascicle, in profile.
  20. Side view of one of the superior setæ commencing on the second thoracic segment.
  21. *Parasabella maculata* sp. nov., p. 201. Pennoned seta from a thoracic torus, different position.
  22. An abdominal seta, in profile.
  23. *Pseudopotamilla debilis* sp. nov., p. 204. Inferior thoracic seta below collar, from specimen from Pacific Grove, California, about  $\frac{3}{4}$  view.
  24. Another from the same fascicle, different position.
  25. *Sabella formosa* sp. nov., p. 196. Pennoned seta from thoracic torus.
  26. *Pseudopotamilla debilis* sp. nov., p. 204. Avicular thoracic uncinus from specimen from Pacific Grove, California.
  27. *Aspeira modesta* sp. nov., p. 202. Pennoned seta from thoracic torus.
  28. Seta from abdomen, in profile.
  29. One of the longer inferior oblanccolate setæ from the fourth thoracic fascicle.
  30. One of the shorter, more nearly spatulate setæ from the same fascicle.
  31. Pennoned seta from the thoracic torus, different position.
  32. *Sabella formosa* sp. nov., p. 196. Pennoned seta from thoracic torus, different position.
  33. *Aspeira modesta* sp. nov., p. 202. Superior lanceolate seta from the fourth thoracic fascicle, back view.
  34. Avicular uncinus from an abdominal torus.
  35. Avicular uncinus from a thoracic torus.

Figures 4-6, 25, 27-30, 32-35 by A. H. Verrill,  $\times 295$ ; the others, by the author,  $\times 300$ .



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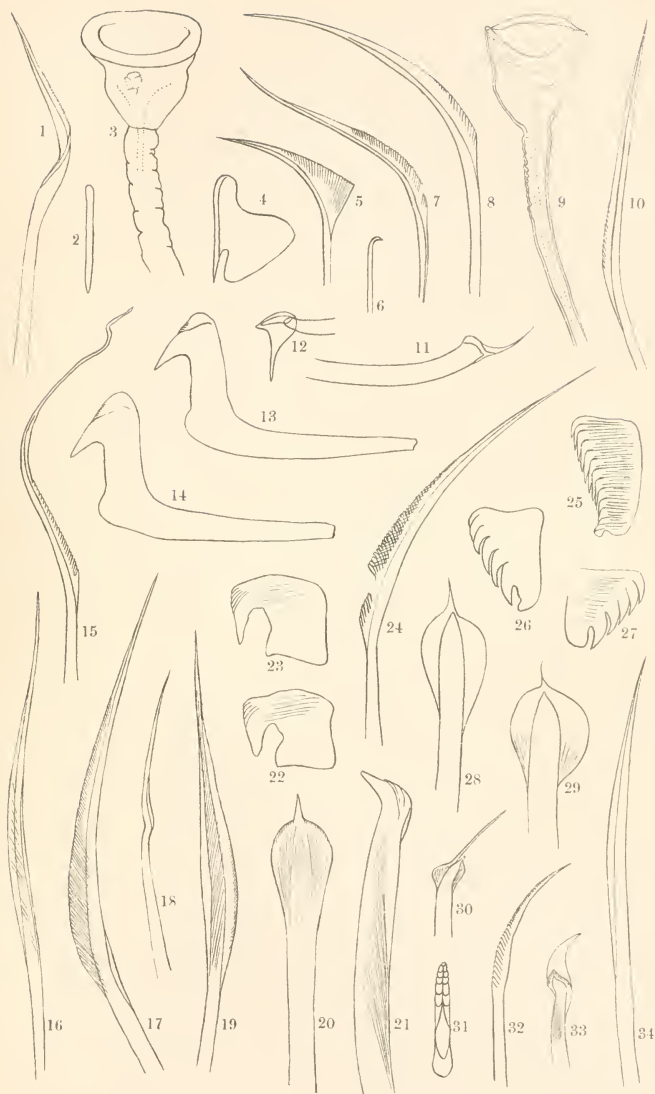






## PLATE XXXVII.

- FIG. 1. *Protula atypa* sp. nov., p. 228. Seta from abdomen of specimen from Pacific Grove, California.
2. Front view of thoracic uncinus apparently without serrations.
3. *Chitinopoma greenlandica* (Mörch) Levinsen, p. 229. Operculum from specimen from Greenland.
4. *Protula atypa* sp. nov., p. 228. Side view of another uncinus from sixth thoracic torus.
5. *Spirorbis validus* Verrill, p. 249. Abdominal seta from specimen from Grand Banks.
6. A simple curved seta from same region.
7. Collar seta showing imperfection in margin.
8. Collar seta from another specimen.
9. *Chitinopoma greenlandica* (Mörch) Levinsen, p. 229. Operculum of specimen on tube of *Nothria conchylega*, from off eastern coast of New England, in 32 fathoms.
10. *Spirorbis validus* Verrill, p. 249. Seta from second thoracic fascicle of animal from Grand Banks.
11. *Pseudopotamilla oculifera* (Leidy), p. 204. Pennoned seta from thorax of specimen from Atlantic Ocean.
12. *Sabella elegans* sp. nov., p. 194. Pennoned seta from thorax.
13. *Pseudopotamilla oculifera* (Leidy), p. 204. Avicular thoracic uncinus from specimen from Atlantic Ocean.
14. Another, showing slight variation.
15. *Spirorbis mörchi* Levinsen, p. 240. Seta from second thoracic fascicle of specimen from the Banks, Atlantic Ocean, in 110-120 fathoms.
16. *Chone teres* sp. nov., p. 215. Seta from first thoracic segment of type, about  $\frac{3}{4}$  view.
17. Seta from abdomen, partly turned.
18. Bayonet seta from thorax.
19. Superior thoracic seta below collar.
20. Inferior thoracic seta below collar.
21. Hooked thoracic seta from fourth segment.
22. Abdominal uncinus.
23. Another, showing variation.
24. *Spirorbis mörchi* Levinsen, p. 240. Collar seta from same specimen as fig. 15.
25. *Spirobranchus incrassatus* (Kröyer), p. 236. Thoracic uncinus from specimen from Central America.
26. *Eupomatus gracilis* sp. nov., p. 234. Thoracic uncinus from specimen from Pacific Grove, California.
27. Abdominal uncinus.
28. *Schizobranchia dubia* sp. nov., p. 208. Inferior thoracic seta below collar, back view.



HELIOTYPE C



PLATE XXXVII—*Continued.*

- FIG. 29. *Pseudopotamilla oculifera* (Leidy), p. 204. Inferior thoracic seta from specimen from Atlantic Ocean, back view.
30. *Parasabella media* sp. nov., p. 200. Pennoned seta from thorax, back view.
31. *Serpula splendens* sp. nov., p. 230. Front view of thoracic uncinus.
32. *Spirorbis validus* Verrill, p. 249. Odd seta from third thoracic fascicle of specimen from Grand Banks.
33. *Sabella elegans* sp. nov., p. 194. Another pennoned seta from thoracic torus, back view.
34. *Spirobranchus incrassatus* (Kröyer), p. 236. Thoracic seta.
- Figures by the author: 2, 4, 26, 27, 31,  $\times$  330; 3, 9,  $\times$  50; the others,
- $\times$  295.

## PLATE XXXVIII.

- FIG. 1. *Myxicola conjuncta* sp. nov., p. 217. Seta from thorax, side view.  
 2. Another seta from a thoracic fascicle, side view.  
 3. Only hooked seta found on sixth thoracic segment.  
 4. Dark, sharply pointed, spear-shaped seta from eighth thoracic segment.  
 5. Seta from a thoracic fascicle, back view.  
 6. Light-colored spear-shaped seta from abdomen.  
 7. Only hooked seta found on seventh thoracic segment.  
 8. Only hooked seta found on fourth thoracic segment, more turned.  
 9. Dark spear-shaped seta from eighth thoracic segment, more blunt than fig. 4.  
 10. Uncial plate from abdomen.  
 11. Another, showing variation in form.  
 12. *Myxicola glacialis* sp. nov., p. 218. Uncial plate from fourth segment (first abdominal).  
 13. *Myxicola steenstrupi* Krøyer, p. 218. Uncial plate from abdomen of a specimen from the Bay of Fundy.  
 14. Another, showing variation in form.  
 15. One of the 4 or 5 hooked setæ from sixth thoracic segment.  
 16. Another from seventh thoracic segment, more turned.  
 17. *Myxicola affinis* sp. nov., p. 218. Uncial plate from abdomen of specimen from Pacific Grove, California.  
 18. Another, showing variation in form.  
 19. Hooked seta from thorax.  
 20. Another, different view.  
 21. *Myxicola steenstrupi* Krøyer, p. 218. Hooked seta from eighth thoracic segment of same specimen as fig. 13.  
 22. Another from same segment, different view.  
 23. *Myxicola glacialis* sp. nov., p. 218. Uncial plate from abdomen of another specimen.  
 24. *Myxicola steenstrupi* Krøyer. Seta from thorax of same specimen as fig. 13, nearly back view, similar to those on abdomen.  
 25. *Myxicola glacialis* sp. nov., p. 218. Seta from second thoracic segment of same specimen as fig. 12, back view.  
 26. Seta from first thoracic segment of same specimen, back view.  
 27. Seta from abdomen of same specimen as fig. 23, back view.  
 28. Abdominal seta from same specimen.  
 29. Seta from thorax of same specimen, back view.  
 30. Sharp spear-shaped seta from thorax of same specimen.  
 31. One of 4 hooked setæ from third thoracic segment of same specimen as fig. 12.  
 32. Blunter spear-shaped seta from thorax of same specimen as fig. 30.  
 All the figures by the author,  $\times 530$ .



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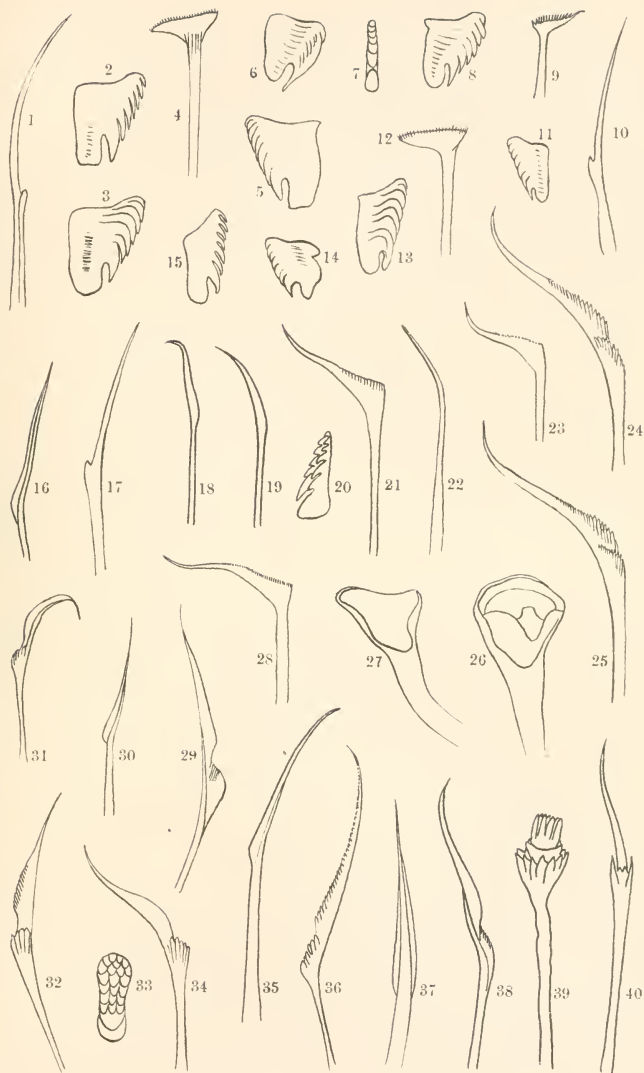






## PLATE XXXIX.

- FIG. 1. *Crucigera irregularis* sp. nov., p. 234. Collar seta from type.
2. Uncial plate from thorax.
3. Uncial plate from abdomen.
4. Seta from abdomen.
5. Another uncial plate from thorax.
6. *Crucigera formosa* sp. nov., p. 233. Uncial plate from thorax of type, showing abnormal development.
7. Abdominal uncinus, front view.
8. *Crucigera zygophora* (Johnson), p. 233. Abdominal uncinus.
9. *Spirorbis eximius* sp. nov., p. 239. Caudal seta from specimen from Pacific Grove, California.
10. *Crucigera formosa* sp. nov., p. 233. Collar seta.
11. Abdominal uncinus.
12. *Crucigera zygophora* (Johnson), p. 233. Abdominal seta.
13. Thoracic uncinus.
14. *Crucigera formosa* sp. nov., p. 233. Another uncinus from thorax, more normally developed than fig. 6.
15. *Crucigera zygophora* (Johnson), p. 233. Another abdominal uncinus.
16. *Spirorbis similis* sp. nov., p. 242. Seta from second thoracic fascicle.
17. *Crucigera zygophora* (Johnson), p. 233. Collar seta.
18. *Spirorbis formosus* sp. nov., p. 251. Collar seta.
19. Another, from different specimen.
20. *Crucigera zygophora* (Johnson), p. 233. Thoracic uncinus, about  $\frac{3}{4}$  view.
21. *Spirorbis spirillum* (Linné) var. *lucidus* (Montagu), p. 243. Collar seta from specimen from Casco Bay.
22. Capillary seta from thorax of a specimen from Pacific coast.
23. Collar seta from another specimen from Atlantic coast.
24. *Spirorbis variabilis* sp. nov., p. 238. Collar seta.
25. Another, showing variations in serrations.
26. *Spirorbis marioni* Caullery and Mesnil, p. 239. Nearly front view of operculum, showing calcareous plate of specimen from Mexico.
27. Side view of same.
28. *Spirorbis spirillum* (Linné) var. *lucidus* (Montagu), p. 243. Collar seta from specimen from Pacific Grove, California.
29. *Spirorbis lineatus* sp. nov., p. 242. Collar seta.
30. *Spirorbis tubæformis* sp. nov., p. 251. Seta from second thoracic fascicle of specimen from Long Island Sound.
31. *Spirorbis similis* sp. nov., p. 242. Collar seta from immature specimen.
32. *Spirorbis tubæformis* sp. nov., p. 251. Collar seta from same specimen as fig. 30.
33. *Serpula splendens* sp. nov., p. 230. Caudal uncinus, front view, much enlarged.



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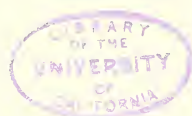


PLATE XXXIX—*Continued.*

- FIG 34. *Spirorbis spirorbis* (Linné), p. 262. Collar seta from specimen from Gloucester, Massachusetts, Atlantic coast.
35. *Spirorbis abnormis* sp. nov., p. 245. Collar seta, short one.
36. *Spirorbis cancellatus* Fabricius, p. 248. Collar seta.
37. *Spirorbis quadrangularis* Stimpson, p. 241. Back view of seta from second thoracic fascicle, from Greenland.
38. *Spirorbis stimpsoni* Verrill, p. 250. Collar seta, about  $\frac{3}{4}$  view.
39. *Eupomatus humilis* sp. nov., p. 235. Operculum from specimen from Mexico.
40. Collar seta, front view, showing arrangement of four basal spines.
- All the figures by the author: 1, 10, 17, 26, 27, 39,  $\times$  68; the others, except 33,  $\times$  425.

## PLATE XL.

- FIG. 1. *Spirorbis abnormis* sp. nov., p. 245. Front view of calcareous plate from operculum of a young specimen.
2. Side view of same.
3. *Hyalopomatopsis occidentalis* sp. nov., p. 229. Abdominal seta.
4. *Spirorbis variabilis* sp. nov., p. 238. Caudal seta.
5. *Spirorbis spirorbis* (Linné), p. 262. Collar seta of specimen from Gloucester, Massachusetts, back view.
6. Odd seta from third thoracic fascicle, about  $\frac{3}{4}$  view.
7. *Spirorbis spirillum* (Linné) var. *lucidus* (Montagu), p. 243. Caudal seta of specimen from Pacific.
8. *Spirorbis spirorbis* (Linné), p. 262. Entire seta from one of a chain of embryos taken from tube.
9. *Spirorbis similis* sp. nov., p. 242. Collar seta.
10. *Spirorbis quadrangularis* Stimpson, p. 241. Collar seta of specimen from Greenland, about  $\frac{3}{4}$  view.
11. Curved abdominal seta.
12. *Spirorbis spirorbis* (Linné), p. 262. Collar seta from another specimen.
13. Seta from second or third thoracic fascicle.
14. Side view of odd seta from third thoracic fascicle.
15. Caudal seta.
16. *Spirorbis marioni* Caullery and Mesnil, p. 239. Collar seta of specimen from Mexico.
17. *Spirorbis similis* sp. nov., p. 242. Back view of operculum of a young specimen, showing calcareous plate.
18. Front view of same.
19. *Spirorbis incongruus* sp. nov., p. 241. Front view of calcareous plate from operculum.
20. Back view of same.
21. *Spirorbis quadrangularis* Stimpson, p. 241. Seta from second or third thoracic fascicle, in profile.
22. *Hyalopomatopsis occidentalis* sp. nov., p. 229. Collar seta, basal fin much spread.
23. *Spirorbis quadrangularis* Stimpson, p. 241. Collar seta of specimen from the Banks, Atlantic Ocean.
24. *Spirorbis granulatus* Linné, p. 247. Collar seta of specimen from the Banks, Atlantic Ocean.
25. *Spirorbis* sp. Collar seta.
26. *Spirorbis quadrangularis* Stimpson, p. 241. Base of collar seta (blade broken) from specimen from Greenland.
27. *Spirorbis cancellatus* Fabricius, p. 248. Collar seta.
28. *Spirorbis incongruus* sp. nov., p. 241. Collar seta.
29. *Spirorbis simpsoni* Verrill, p. 250. Odd seta from third thoracic fascicle.



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PLATE XL— *Continued.*

- FIG. 30. *Spirorbis quadrangularis* Stimpson, p. 241. Caudal seta of specimen from Greenland.
31. *Chitinopoma greenlandica* (Mörch) Levinsen, p. 229. One of the shorter collar setæ (longest ones broken) of specimen on tubes of *Nothria conchylega* from off the eastern coast of New England, in 32 fathoms.

All figures by the author: 1, 2, 17-20,  $\times 65$ ; others,  $\times 398$ .

(339)

## PLATE XLI.

- FIG. 1. *Spirorbis violaceus* Levensen, p. 242. Collar seta from specimen from the Grand Banks, Atlantic Ocean.
2. Another collar seta.
3. *Spirorbis verruca* (Fabricius), p. 247. Collar seta showing slight posterior notch in margin, from specimen on *Chlamys islandicus* from Greenland.
4. *Spirorbis asperatus* sp. nov., p. 245. Collar seta (serrations too distinctly marked).
5. Abdominal seta, back view.
6. Collar seta of another specimen (serrations invisible).
7. *Spirorbis eximius* sp. nov., p. 239. Seta from second thoracic segment of specimen from Pacific Grove, California.
8. *Spirorbis asperatus* sp. nov., p. 245. Curved shaft associated with abdominal seta.
9. *Spirorbis sulcatus* (Adams), p. 249. Collar seta from specimen on *Haliotis* from Guernsey, England.
10. *Spirorbis asperatus* sp. nov., p. 245. Abdominal seta (no serrations), profile view.
11. Apparent arrangement of teeth on uncini, greatly enlarged.
12. *Spirorbis verruca* (Fabricius), p. 247. Another collar seta showing but very slight indication of posterior notch.
13. *Spirorbis semidentatus* sp. nov., p. 237. Capillary seta from thorax.
14. *Spirorbis vitreus* (Fabricius), p. 247. Collar seta from specimen from the Banks, Atlantic Ocean.
15. *Spirorbis mörchi* Levensen, p. 240. Caudal seta from Alaska specimen, back view.
16. Another, in profile.
17. *Spirorbis semidentatus* sp. nov., p. 237. Caudal seta.
18. *Spirorbis eximius* sp. nov., p. 239. Collar seta.
19. *Spirorbis asperatus* sp. nov., p. 245. Uncial plate from thorax, about  $\frac{3}{4}$  view.
20. *Spirorbis eximius* sp. nov., p. 239. Odd seta from third thoracic fascicle.
21. *Spirorbis mörchi* Levensen, p. 240. Collar seta from specimen on *Chlamys islandicus* from Greenland.
22. *Spirorbis formosus* sp. nov., p. 251. Caudal seta from specimen from Bermuda.
23. *Spirorbis semidentatus* sp. nov., p. 237. Another caudal seta.
24. *Spirorbis mörchi* Levensen, p. 240. Seta from third thoracic fascicle of Alaska specimen.
25. Collar seta from same specimen.
26. *Spirorbis semidentatus* sp. nov., p. 237. Seta from second or third fascicle.



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PLATE XLI—*Continued.*

- FIG. 27. Collar seta turned, showing upper surface.  
28. Uncial plate from thorax, in profile.  
29. Collar seta, in profile.  
30. Odd seta of third thoracic fascicle, end spread open.  
31. *Spirorbis asperatus* sp. nov., p. 245. Uncial plate; apparent aspect.  
of front surface.  
32. Uncial plate from thorax, in profile.  
All figures by the author,  $\times 355$ , except 11 and 31, more enlarged.

## PLATE XLII.

- FIG. 1. *Spirorbis spirillum* (Linné) var. *lucidus* (Montagu), p. 243. Back view of a calcareous plate from an operculum of specimen from Greenland.
2. Nearly front view of an operculum showing calcareous plate from another specimen from Greenland.
3. Calcareous plate from operculum of a specimen (typical *lucidus*) from Casco Bay.
4. Operculum of specimen from same locality, showing calcareous plate covered with a minute seaweed.
5. Back view of fig. 3.
6. *Spirorbis vitreus* (Fabricius), p. 247. Calcareous plate from operculum of specimen from the Banks, Atlantic Ocean.
7. Top view of same.
8. *Spirorbis violaceus* Levinsen, p. 242. Operculum showing calcareous plate of specimen from Grand Banks.
9. Opposite view of same.
10. Bottom view of calcareous plate from another operculum.
11. Back view of same.
12. Front view of same.
13. *Spirorbis tubæformis* sp. nov., p. 251. Back view of an operculum showing calcareous plate of specimen from Long Island Sound.
14. Front view of same, the plate covered with seaweed.
15. *Spirorbis spirorbis* (Linné), p. 236. Back view of an operculum from a full-grown specimen from Gloucester, Massachusetts.
16. Side view of an operculum of a medium sized specimen, showing calcareous plate.
17. Front view of fig. 15; the plate covered with minute protozoans.
18. Back view of an operculum showing operculum plate, of a young specimen.
19. Front view of same.
20. *Spirorbis evolutus* sp. nov., p. 251. Front view of an operculum showing calcareous plate of specimen from Grand Banks.
21. Opposite view of same.
22. Side view of same.
23. *Spirorbis quadrangularis* Stimpson, p. 241. Side view of calcareous plate of specimen from Greenland.
24. Front view of calcareous plate, fig. 28.
25. Back view of same.
26. Opposite view of fig. 23.
27. Side view of operculum of a specimen from Greenland collected and identified as *S. granulatus* by Moore, 1902.
28. Front view of another operculum from specimen from same locality.
29. Opposite view of same.



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PLATE XLII—*Continued.*

- FIG. 30. *Spirorbis cancellatus* (Fabricius), p. 248. Bottom view of a calcareous plate.
31. Nearly front view of same.
32. Operculum showing calcareous plate becoming detached.
33. Back view of fig. 31.
34. Opposite view of fig. 32.
- All figures by the author,  $\times 43$ .

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## PLATE XLIII.

- FIG. 1. *Spirorbis asperatus* sp. nov., p. 245. Front view of operculum showing calcareous plate.
2. Front view of a calcareous plate from another operculum.
3. Back view of same.
4. *Spirorbis semidentatus* sp. nov., p. 237. Calcareous plate from operculum.
5. Top view of same.
6. *Spirorbis eximius* sp. nov., p. 239. Calcareous plate from operculum of type, from Pacific Grove, California, bottom view.
7. *Spirorbis asperatus* sp. nov., p. 245. Back view of a calcareous plate from a smaller operculum.
8. *Spirorbis sulcatus* (Adams), p. 249. Front view of calcareous plate from operculum of specimen on *Haliotis* from Guernsey, England.
9. *Spirorbis spirillum* Linné, p. 243. Calcareous plate from operculum of specimen from Sitka, front view.
10. Back view of same.
11. *Spirorbis eximius* sp. nov., p. 239. Calcareous plate of operculum from type, nearly side view.
12. *Spirorbis semidentatus* sp. nov., p. 237. Operculum showing calcareous plate.
13. *Spirorbis asperatus* sp. nov., p. 245. Side view of an operculum showing calcareous plate.
14. *Spirorbis quadrangularis* Stimpson, p. 241. Operculum showing eggs and calcareous plate, from Greenland.
15. Operculum, in profile, from specimen from Alaska.
16. *Spirorbis variabilis* sp. nov., p. 238. Calcareous plate from operculum, to show the separation of two disks.
17. *Spirorbis eximius* sp. nov., p. 239. Front view of operculum showing calcareous plate.
18. *Spirorbis formosus* sp. nov., p. 251. Operculum of a medium sized animal, with empty calcareous cylinder.
19. *Spirorbis sulcatus* (Adams), p. 249. Back view of fig. 8.
20. *Spirorbis stimpsoni* Verrill, p. 250. Operculum showing primary calcareous plate.
21. Another operculum filled with embryos, with secondary calcareous plate.
22. Back view of fig. 20.
23. *Spirorbis formosus* sp. nov., p. 251. Posterior portion of operculum showing renewal of plate.
24. *Spirorbis abnormis* sp. nov., p. 245. Back view of fig. 28.
25. *Spirorbis formosus* sp. nov., p. 251. Operculum showing calcareous cylinder filled with embryos.
26. *Spirorbis asperatus* sp. nov., p. 245. Front view of calcareous plate from a small operculum.





PLATE XLIII—*Continued.*

- FIG. 27. *Spirorbis similis* sp. nov., p. 242. Back view of operculum filled with eggs.
28. *Spirorbis abnormis* sp. nov., p. 245. Operculum showing one plate, the other being torn away. Embryos with large white patches which filled the operculum are not represented.
29. Front view of another operculum with 3 calcareous plates.
30. *Spirorbis formosus* sp. nov., p. 251. Detached calcareous cylinder showing interior.
31. *Spirorbis similis* sp. nov., p. 242. Front view of fig. 27, showing calcareous plate.
32. *Spirorbis granulatus* (Linné), p. 247. Operculum filled with embryos, showing conspicuous white patches and primary calcareous plate on the top, splitting from secondary one. Specimen from off New England coast, in 110-120 fathoms.
- All figures by the author,  $\times 35$ .

## PLATE XLIV.

- FIG. 1. *Spirorbis verruca* (Fabricius), p. 247. Back view of a double operculum plate showing the primary and secondary ones before separation.
2. *Hyalopomatopsis occidentalis* sp. nov., p. 229. Operculum, in which a delicate yellowish (horny ?) cap is partially defined.
3. *Pomatoceros triquetra* (Linné), p. 222. Operculum plate from a specimen from Denmark in the Yale University Museum.
4. *Hyalopomatopsis occidentalis* sp. nov., p. 229. Another operculum, less convex on top, showing conspicuous air-bubble.
5. *Spirorbis* sp.? Operculum showing a large calcareous plate, from an animal forming a tube which resembles that of *Spirorbis spirorbis* (Linné) from Greenland. As the collar setæ could not be found, the species remains undetermined. It may be the very young of one of the larger forms.
6. The same operculum in another position.
7. *Protula media* Stimpson, p. 228. Reproduction of Professor Verrill's figure published in Transactions of the Connecticut Academy, 1874.
8. *Hyalopomatopsis occidentalis* sp. nov., p. 229. Operculum from a full-grown animal, showing distinct central cavity and canal in peduncle, on the end of which algæ are growing.
9. Outline sketch of the anterior portion of a young animal.
10. *Spirorbis* sp.? Operculum of animal from Alaska.
11. *Spirorbis validus* Verrill, p. 249. Back view of a calcareous plate.
12. The same plate in another position.
13. Opposite view to fig. 11.
14. A double plate showing primary one about splitting away. Both specimens were on *Buccinum* from the Grand Banks, in 36-51 fathoms.
15. *Spirorbis* sp.? Front view of fig. 5.
16. *Spirorbis verruca* (Fabricius), p. 247. Opposite view to fig. 1.
17. *Spirorbis variabilis* sp. nov., p. 238. Operculum with minute protozoans on end, side view.
18. *Spirorbis rugatus* sp. nov., p. 243. Front view of operculum showing plate.
19. Side view.
20. *Spirorbis mörchi* Levinsen, p. 240. Operculum showing large calcareous cap, from specimen from off the eastern coast of New England, in 110-120 fathoms.
21. Back view of another operculum, showing eggs.
22. *Eupomatus humilis* sp. nov., p. 235. Operculum greatly enlarged.
- All figures by the author,  $\times 30$ , except 3,  $\times 90$ ; 7,  $\times \frac{1}{2}$ , and 22,  $\times 278$ .



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